

LENOX CHINA
A DIVISION OF LENOX, INC.
POMONA, NEW JERSEY

104

RCRA FACILITY INVESTIGATION
HEALTH AND SAFETY PLAN

PROJECT #530-7
MARCH 1993

EDER ASSOCIATES
CONSULTING ENGINEERS, P.C.
Locust Valley, New York
Madison, Wisconsin
Ann Arbor, Michigan
Augusta, Georgia
Jacksonville, Florida
Trenton, New Jersey

EL3202

032993

651265



TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION	1
2.0 FACILITY DESCRIPTION	3
3.0 HAZARD EVALUATION	5
3.1 Activity-Specific Hazards and Standard Operating Procedures	5
3.1.1 Soil Boring/Monitoring Well Installation	5
3.1.2 Soil and Groundwater Sampling	6
3.1.3 Sediment Sampling	7
3.1.4 Sampling Equipment Decontamination	7
3.2 Chemical Hazard	8
3.3 Biological Hazards	8
4.0 KEY PERSONNEL AND RESPONSIBILITIES	10
5.0 WORK AREA DEFINITION AND SITE ENTRY PROCEDURES	13
6.0 PERSONNEL PROTECTION	15
6.1 Level D	15
6.2 Level C	15
6.3 Activity-Specific Levels of Personal Protection	16
6.4 Surveillance Equipment and Materials	16
6.5 Medical Surveillance	17
6.6 Personnel Safety/Hygiene	17
6.7 Personnel Training	18
7.0 DECONTAMINATION PROCEDURES	20
8.0 AIR QUALITY MONITORING	22
9.0 EMERGENCY CONTINGENCY PLAN	23
9.1 Emergency Equipment On-Site	24
9.2 Emergency Contacts	24
9.3 Personnel Responsibilities During an Emergency	25
9.4 Medical Emergencies	25
9.5 Fire or Explosion	26
9.6 Evacuation Routes	26
9.7 Spill Control Procedures	27
9.8 Emergency Response Protocols	27
9.9 Emergency Route to Local Hospital	28
10.0 CONFINED SPACE	29
APPENDIX A - HEAT AND COLD STRESS CASUALTY PREVENTION PLAN	
APPENDIX B - CHEMICAL DATA SHEETS	
APPENDIX C - CALIBRATION, OPERATION AND ROUTINE MAINTENANCE PROCEDURES FOR FIELD EQUIPMENT	

TABLE OF CONTENTS

- continued -

LIST OF TABLES

No. Description

1 Health and Safety Training Records

No. Description

1 Location Map Drawing from Facility Background Report

2 Site Map Drawing from Facility Background Report

3 Route to Hospital

1.0 INTRODUCTION

This Health and Safety Plan (HASP) will be implemented during the Resource Conservation and Recovery Act Facility Investigation (RFI) at the Lenox China, a division of Lenox, Inc. (Lenox) property in Pomona, Atlantic County, New Jersey. This HASP addresses the requirements contained in Appendix C of Lenox's NJPDES - DGW Permit (No. NJ0070343).

This HASP applies to Eder Associates Consulting Engineers, P.C. (Eder) personnel involved in RFI activities where Eder operations at the site involve employee exposure or the reasonable possibility of employee exposure to safety or health hazards. Eder's policy is to minimize the possibility of work-related injury through aware and qualified supervision, health and safety training, medical monitoring and the use of appropriate personal protective equipment. Eder has established a guidance program and intends that the policy be implemented in a manner that protects its personnel to the maximum reasonable extent. The Corporate Health and Safety Program is documented in Appendix A of the Eder Employee Handbook, which is issued to each employee.

This HASP describes emergency response procedures and actual and potential physical and chemical hazards at the worksite. This HASP also provides information and guidance to contractors retained by Eder or Lenox and to other parties who are outside of Eder's ability to control.

Notwithstanding the intent of this HASP as site specific hazard information and guidance, contractors are retained as independent contractors and are responsible for assuring the worksite safety of all of their employees and any other party retained by contractor. This HASP is made available to all

parties, however, Eder has no control over the actions of any other party and all parties enter the worksite with this understanding.

Eder may require that its personnel take certain safety related precautions in accord with this HASP and Eder requests that others protect their personnel in a manner as they deem necessary or sufficient.

This HASP was developed with the most recent and available information including applicable regulatory requirements (OSHA 29 CFR Parts 1910, 1926) and state and local codes. Activities governed by this HASP will be performed in conjunction with the Lenox Plant health and safety procedures and human resource personnel responsible for health and safety. If, during the RFI work, additional safety measures are required, this HASP will be amended accordingly. In addition, the site project manager/safety officer may increase or decrease personnel protective measures used at the area based on site conditions. All workers will be briefed on any amendments made to this plan.

2.0 FACILITY DESCRIPTION

The Lenox manufacturing facility in Pomona, New Jersey is a modern, slab on grade, single-story structure located on 56 acres of level land in a light industrial, rural area as shown on Figure 1. Directly across the street from Lenox is an almost completed golf course and future planned residential development. Figure 2 shows the location of the Solid Waste Management Units (SWMUs) and surrounding land use, property lines with present owners of all adjacent property indicated, and locations of all monitoring wells.

This manufacturing facility was placed into operation in 1954 and initially had 145,000 square feet of manufacturing area and 8,000 square feet of office space. Additions to the facility were made in 1964, 1968 and 1979 and, at the present time, the manufacturing facility has a total of 346,000 square feet and an office encompassing 243,000 square feet. In addition, separate warehouses and other miscellaneous buildings have a total of 45,000 square feet. Operations at the facility include the manufacture of fine china giftware, tableware and hollowware. The facility employs approximately 1,100 people and is served by public sewer, gas and electric. Water is supplied to the plant by two on-site wells. Treated industrial wastewater is discharged both directly to a receiving stream, a ditch which discharges into the Jack Pudding Branch of the Babcock Swamp, and to the Atlantic County Utilities Authority (ACUA) sanitary system.

The manufacture of china includes the preparation of a clay body using various clay components that are shipped to the plant by rail and truck. The clay is mechanically processed in a water solution (slip) and dewatered by filter pressing or placing the slip in plaster molds. The first firing of the formed pieces is accomplished in bisque kilns. After this initial firing, the china

is coated with glaze and fired again in a glost kiln. Decorations are then applied using decals, precious metal paints, mechanical etching or acid etching prior to finial firing in decorating lehrs. Quality inspections take place during the manufacturing process. Final inspection and packing precedes shipping to customers.

The primary hazardous materials used in the manufacturing process are lead, a major component of glaze, and trichloroethylene (TCE) which is used in the acid etching process. The lead is purchased as a fritted lead compound (glass-encased lead).

3.0 HAZARD EVALUATION

This Hazard Evaluation identifies the activity-specific hazards associated with site operations and standard operating procedures (SOPs) that should be implemented to reduce the hazards, identifies general physical hazards that can be expected at the site, and presents an analysis of documented or potential chemical hazards that exist at the site. Every effort must be made to reduce or eliminate these hazards. Those which cannot be eliminated must be guarded against by using engineering controls and/or personal protective equipment.

Activities to be conducted during the RFI include monitoring well installation and sampling of soils, sediments, and groundwater. The RFI Work Plan will describe these activities in detail.

3.1 Activity-Specific Hazards and Standard Operating Procedures

3.1.1 Soil Boring/Monitoring Well Installation

Hazards

- Inhalation of dust and/or volatile vapors;
- Skin contact with contaminants from drill cuttings/ groundwater or handling equipment;
- Physical impact with equipment;
- Slip/trip/fall;
- Noise;
- Underground utilities;
- Explosion/fire; and
- Heat stress and/or cold stress.

SOPs to Avoid Hazards

- Wear appropriate respiratory protection, if deemed necessary, based on air monitoring using a PID/FID;
- Wear appropriate personal protective equipment (gloves, tyvek, overboots, etc.);
- Avoid the use of loose belts, drawstrings, loose straps that might catch on drill rig, and keep work areas free of obstructions;
- Become familiar with site topography and layout. Keep all tools and equipment in a designated area;
- Wear hearing protection when working in close proximity to drill rig or heavy equipment;
- Call utility markout service before drilling at site;
- Maintain fire extinguisher or other fire fighting equipment in work area; and
- Ensure that all site personnel are familiar with the symptoms of heat stress and cold stress outlined in Appendix A.

3.1.2 Soil and Groundwater Sampling

Hazards

- Inhalation of volatile compounds;
- Skin contact with contaminated soil and groundwater;
- Slip/trip/fall; and
- Heat stress and/or cold stress.

SOPs to Avoid Hazards

- Wear appropriate respiratory protection, if deemed necessary, based on air monitoring using a PID/FID;
- Wear appropriate personal protective equipment (gloves, tyvek, overboots, etc.);

- Become familiar with site topography and layout. Keep all tools and equipment in a designated area; and
- Ensure that all site personnel are familiar with the symptoms of heat stress and cold stress outlined in Appendix A.

3.1.3 Sediment Sampling

Hazards

- Skin contact with contaminated sediments and water;
- Slip/trip/fall; and
- Heat stress and/or cold stress.

SOPs to Avoid Hazards

- Wear protective gloves and waders;
- Avoid slippery, moss-covered and irregular surfaces; and
- Ensure that all site personnel are familiar with the symptoms of heat stress and cold stress outlined in Appendix A.

3.1.4 Sampling Equipment Decontamination

Hazards

- Inhalation of volatile vapors;
- Skin contact with contaminants from splash;
- Slipping on wet surfaces; and
- Heat stress and/or cold stress.

SOPs to Avoid Hazards

- Wear appropriate respiratory protection, if deemed necessary, based on air monitoring using a PID/FID;

- Wear protective gloves during decontamination;
- Ensure that all site personnel are familiar with the symptoms of heat/cold stress outlined in Appendix A.

3.2 Chemical Hazards

Previous investigations indicate that TCE is the primary contaminant of concern in the groundwater beneath the site. Low concentrations of other VOCs were detected in one or more wells, however, their occurrence was sporadic compared to the TCE. Iron was detected at concentrations above Federal and State drinking water standards in unfiltered samples, however, it did not exceed drinking water standards in the dissolved phase. Zinc was detected in groundwater from MW-3 near the former glaze basin. Lead has not been detected above the drinking water standards, however it is one of the primary hazardous materials used at the site. Material safety data sheets for the primary compounds of concern (TCE, iron, lead, and zinc) at the site are included in Appendix B.

During the RFI, if other contaminants are identified in concentrations which may warrant additional safety precautions, this plan will be amended, as necessary, to address these potential health hazards.

3.3 Biological Hazards

Biological agents can cause infection or disease to persons who are exposed, and may involve plants, animals or insects. Many biological agents require a carrier, such as bees, ticks, and snakes, to inoculate a host. Therefore, controlling the agent may require controlling or avoiding the carrier. The most common biological agents that may be encountered at the site are ticks, and poison ivy/poison oak. Workers should wear light colored, long sleeve shirts and pants while working at the site. Workers will not be permitted to wear shorts on-site. If ticks are found on a

worker, a first-aid kit that contains antiseptic and tweezers will be available at the site. Workers should be familiar with the identification of common poisonous plants, such as poison ivy and poison oak.

4.0 KEY PERSONNEL AND RESPONSIBILITIES

The following organization and responsibilities relate to the Lenox RFI work.

Frederick H. Inyard, P.E.
Principal-in-Charge, Quality Assurance Officer
Eder Associates

Nicholas A. Andrianas, P.E.
Vice President, Senior Environmental Engineer
Eder Associates

John Kinkela
Environmental Engineer
Lenox China

Nora Brew
Project Engineer
Eder Associates

James Barish
Project Hydrogeologist
Eder Associates

Mark Foley
Project Hydrogeologist
Eder Associates

The principal-in-charge is responsible for overall RFI project administration. James Barish will be the on-site health and safety officer (HSO), and will oversee daily safety issues during RFI work

and ensure that the HASP is implemented. Mark Foley will be the alternate on-site HSO.

All applicable OSHA health and safety standards not specifically stated in the HASP shall be followed. Each contractor (as an employer under OSHA) is also responsible for the health and safety of its employees. If there is any dispute about health and safety or project activities, on-site personnel shall attempt to resolve the issue on-site; if the issue cannot be resolved, on-site personnel shall consult the Project Manager for resolution.

The qualifications of the HSO comply with the OSHA training requirements (29 CFR Part 1910). The HSO has the authority to suspend site work based on safety concerns. The general responsibilities of the HSO are as follows:

1. The implementation, enforcement and monitoring of this HASP.
2. The indoctrination of all personnel with regard to all of the information in this safety plan and any other safety requirements to be observed during work area operations, including:
 - a. Potential hazards;
 - b. Designation of key staff responsibilities;
 - c. Designation of work zones and levels of protection;
 - d. Decontamination procedures;
 - e. Air monitoring;
 - f. Personnel hygiene principles;
 - g. Personnel protective equipment;
 - h. Respiratory protective equipment usage and fit testing; and
 - i. Emergency procedures dealing with fire and medical situations.

3. Enforcement of "work areas" and site entry procedures.
4. Monitoring of air quality and all other hazards during study area operations.
5. Maintenance of a log documenting: (a) names of personnel in the exclusion zone and their site entry and exit times; (b) safety problems encountered and mitigative actions taken; and (c) any chemical exposure symptoms exhibited by workers.

Any person who observes safety concerns or potential hazards that have not been addressed in the daily safety meetings should immediately report observations/concerns to the HSO or other appropriate key personnel.

5.0 WORK AREA DEFINITION AND SITE ENTRY PROCEDURES

Sampling and well installation locations will be identified in the RFI Workplan. A thirty foot radius area around each sampling point and boring/well installation location will define the "work area". Access to work areas is restricted to personnel who are familiar with this HASP and who have received OSHA-required (29 CFR 1910) training.

Decontamination areas will be established by the HSO and will be used to decontaminate auger flights, split spoons, and ancillary drilling equipment, tools, and monitoring well materials. Portable decontamination areas will be established to decontaminate bucket augers, tube samplers, bailers, and trowels. A figure showing the location of the exclusion zone, the contamination-reduction zone and the support zone will be developed based on the RFI Workplan.

All personnel entering the work area will record their names in the site log. Before engaging in any site work, all personnel involved in such work will be briefed on the following:

1. Identity of project manager/safety officer.
2. Boundaries and exit and entry point locations of the study area.
3. Decontamination procedures when required.
4. Chemical contaminants suspected of being in the work area and their signs and symptoms of exposure.
5. Location of first-aid equipment and qualified personnel.

6. Procedures to be used in contacting emergency response personnel, including potential site evacuation procedures in case of emergencies.
7. Location of emergency equipment.
8. Location of emergency meeting point.
9. Contractor staff person in charge.
10. Activities taking place that day.
11. Heat or cold stress symptoms. All personnel will be advised to watch for signs of stress in staff working in the study area.
12. Personal protective equipment requirements and limitations.

The "buddy system" will be used at all times by all field personnel in the exclusion zone. No one is to perform field work alone. When in Level D personal protection, visual contact or radio contact should be maintained at all times.

It is the duty of the HSO to require all personnel entering the work areas at the site including workers and visitors to read this HASP and sign a statement indicating that they have done so.

6.0 PERSONNEL PROTECTION

The selection of personal protective equipment (PPE) shall be conducted in accordance with the site air monitoring program described in Section 8.0 of this HASP, OSHA 29 CFR 1910.120(c) and (g), and 1910.132. Protective equipment shall be NIOSH-approved and the use of respiratory protection shall conform to OSHA 29 CFR 1910.133 and 1910.134 specifications; head protection shall conform to 1910.135; eye and face protection shall conform to 1910.133; and foot protection shall conform to 1910.136.

6.1 Level D

Level D PPE shall be donned when the atmosphere contains no known hazard and work functions preclude splashes, immersion or the potential for unexpected inhalation of, or contact with, hazardous concentrations of harmful chemicals. Level D PPE consists of:

- Standard work uniform or coveralls (or tyvek, as needed);
- Steel toe and steel shank work boots;
- Hard hat;
- Gloves as needed; and
- Safety glasses as needed.

6.2 Level C

Level C PPE shall be donned when the concentrations of measured total organic vapors in the breathing zone are between 5 ppm and 50 ppm, using a PID/FID. The specifications on the air purifying respirator filters used must be appropriate for contaminants identified or expected to be encountered. Level C PPE consists of:

- Chemical resistant or coated tyvek coveralls;
- Steel toe and steel shank workboots;
- Chemical resistant overboots or disposable boot covers;
- Disposable inner gloves (surgical gloves);
- Disposable outer gloves;
- Full-face air purifying respirator fitted with organic vapor/dust and mist filters or filters appropriate for the contaminants identified or expected to be encountered;
- Hard-hat;
- Splash shield, as needed; and
- Ankles/wrists taped with duct tape.

6.3 Activity-Specific Levels of Personal Protection

All RFI work will be performed in Level D PPE. This level of protection may be changed during site work based on the air quality monitoring discussed in Section 8.0.

6.4 Surveillance Equipment and Materials

Before commencing on-site drilling, air sampling will be performed around the perimeter of the work zone using a PID/FID to establish background VOC conditions. A discussion of the sampling procedures appears in Section 8.0 of this HASP.

During any work at the site, air quality will be monitored for organic vapors as required by field conditions.

During soil drilling activities, organic vapor measurements will be taken in the boreholes prior to collecting each split spoon sample.

6.5 Medical Surveillance

In accordance with the USEPA's "Standard Operating Safety Guides" and OSHA CFR 29 Part 1910.120 (f), a yearly medical exam of the general state of health, baseline physiological data and ability to wear personal protective equipment will be required for individuals engaged in on-site work activities. This HASP for the RFI work addresses only emergency medical care and treatment.

6.6 Personnel Safety/Hygiene

The following safety practices shall be followed by all on-site personnel:

1. Eating, drinking, chewing gum or tobacco, smoking, or any similar practice is prohibited in the work and decontamination areas.
2. Hands and face must be thoroughly washed upon leaving the work area.
3. Whenever decontamination procedures for outer garments are in effect, it is recommended that the entire body be thoroughly washed as soon as possible after the protective garment is removed.
4. No excessive facial hair, which interferes with a satisfactory fit of the mask-to-face seal, is allowed for personnel required to wear respiratory protective equipment.
5. Contact with potentially contaminated surfaces in the work area should be avoided. Whenever possible, do not walk through puddles, mud, and other discolored surfaces;

kneel on ground; or lean, sit or place equipment on drums, containers, vehicles, or the ground.

6. Medicine and alcohol can exaggerate the effects from exposure to toxic chemicals. Prescribed drugs should not be taken by personnel where the potential for absorption, inhalation, or ingestion of toxic substances exists unless specifically approved by a qualified physician. Alcoholic beverages will not be allowed on-site.

Fluids will be provided to staff to replace perspiration. All fluids for ingestion will be kept in sealed containers outside of the work area.

The protective outer wear worn by workers will decrease body ventilation, which increases the potential for heat casualties. Extended outdoor work during cold periods may result in cold stress hazards. Site personnel will be instructed in the identification of a heat/cold stress victim, the first-aid treatment procedures, and the prevention of heat/cold stress casualties. A Heat/Cold Casualty Prevention Plan (Appendix A) describes the symptoms and treatment for heat exhaustion, heat stroke, hypothermia and frostbite, and lists precautions to prevent heat/cold stress.

The following equipment will be maintained on-site for use in the event of an emergency:

1. Twenty pound ABC type dry chemical fire extinguishers.
2. An industrial first-aid kit.

6.7 Personnel Training

All personnel will be trained in accordance with the OSHA requirements in 29 CFR Part 1910.120(e) prior to working at this site. Training requirements include the initial 40-hour health and

safety course and the 8-hour supervisor and refresher courses. A summary of Eder's health and safety training records for those persons that will or may be conducting field work during the RFI is summarized in Table 1. All on-site personnel directly involved in RFI field activities will be briefed by the on-site manager/safety officer on the levels of personal protective equipment required for site activities, safety and hygiene procedures, general cleanup procedures, symptoms of chemical exposure, heat/cold stress, work area entry and exit, and notification of emergency personnel. Periodic safety meetings will be held, as necessary, to inform these workers of changes in the safety plan and/or area conditions.

7.0 DECONTAMINATION PROCEDURES

Decontamination procedures will be used when contact is made with the soil and groundwater in the work area. All decontamination procedures will be performed in the designated decontamination area. The following are the personnel decontamination procedures:

1. Reusable boots and other potentially contaminated garments which have come in contact with the soil will be cleaned with detergent/water solution and rinsed with water in wash tubs. The wash water, rinse water and residues will be collected and handled as hazardous waste, until sampling results are received and final disposition of the waste can be determined.
2. All disposable protective clothing (garments, boot covers, gloves, etc.) will be removed in the decontamination area, placed in bags or drums, and disposed of at an approved off-site facility.
3. Spent cartridges/canisters from respiratory equipment will be disposed of with the disposable garments.
4. Impermeable gloves will be worn while decontaminating equipment.
5. Contaminated trash will be disposed of in the drum provided at the decontamination area.
6. Personnel engaged in on-site activities shall wash their hands and face as appropriate before proceeding off-site.

All potentially contaminated equipment will be decontaminated on-site using the following supplies:

1. Water supply and detergent wash solutions.
2. Sheet plastic.
3. Wash and rinse tubs.
4. Scrub brushes.

A decontamination pad will be used for the decontamination of large drilling equipment.

8.0 AIR QUALITY MONITORING

Air quality will be monitored for total organic vapors using a Photovac Microtip^R and Foxboro OVA before beginning the RFI site work. Air monitoring equipment will be calibrated and maintained in accordance with manufacturer's instructions (Appendix C). Sampling will be performed as follows.

1. Organic vapors will be monitored using a photoionization detector instrument.
 - a. At least four measurements will be taken throughout the work area before sampling commences at each work area. These measurements will be considered background volatile organic levels.
 - b. In open boreholes prior to use of the split spoon for sample collection.
 - c. Continuously at each work area during sampling activities, or hourly when personnel are at one work area for a period exceeding one hour. Air monitoring will be performed when different sampling activities are initiated during the one hour interval stated above.
2. All measurements will be logged in a field notebook.
3. Level D protection will be used when organic vapor concentrations are less than 5 ppm.
4. Level C protection would be used in the unlikely event that organic concentrations are between 5 and 50 ppm.

9.0 EMERGENCY CONTINGENCY PLAN

It is essential that site personnel be prepared in the event of an emergency. Emergencies can take many forms; illnesses or injuries, chemical exposure, fires, explosions, spills, leaks, releases of harmful contaminants, or sudden changes in the weather.

Before the start of each day, the HSO will conduct a meeting with all on-site personnel to discuss personnel roles during an emergency, lines of authority and communication, and emergency recognition and prevention. All emergency and PPE equipment will be inspected and tested during the meeting. Safe places of refuge and evacuation routes will be updated on a day-to-day basis to account for changes in work location. Workers will be required to traverse the site to become familiar with site layout and topography prior to the start of work.

If an emergency occurs, a post-emergency meeting with all site personnel will be held to review the cause and resolution of the emergency, and to determine whether the HASP adequately addressed the emergency that occurred. If required, the HASP will be revised to incorporate the information obtained during the post-emergency meeting.

A list of emergency telephone numbers and a map to the hospital will be posted in the command post. Site personnel should be familiar with the emergency incident procedures, and the locations of site safety, first aid, and communication equipment.

9.1 Emergency Equipment On-Site

Private Telephones	Eder mobile phone.
Two-Way Radios	Eder site personnel.
Emergency Alarms	On-site vehicle horns*.
First Aid Kits	On-site Eder vehicle/ Command post.
Fire Extinguisher	On-site Eder vehicle, Drill rig.

*Horns: Air horns will be supplied to personnel at the discretion of the Site Manager or Site Safety Officer.

9.2 Emergency Contacts

Community

	Area Code (609)
Police Department and EMS	965-1200
Fire Department (including Ambulance)	965-1000
Health Department: Atlantic County	645-5971
Hospital: Atlantic City Medical Center	652-1000
Mainland Division	
Jim Leeds Road	
Pomona, New Jersey 02240	

Government Environmental Agencies

National Response Center	1-800-424-8802
Poison Control Center	1-800-962-1253
NJDEPE	609-292-3131

9.3 Personnel Responsibilities During an Emergency

The HSO has primary responsibility to respond to and correct emergency situations.

- Take appropriate measures to protect personnel including: withdrawal from the exclusion zone, total evacuation and securing of the site or upgrading or downgrading the level of protective clothing and respiratory protection;
- Ensure that appropriate Federal, State and local agencies are informed, and emergency response plans are coordinated. In the event of fire or explosion, the local fire department should be summoned immediately. In the event of an air release of toxic materials, the local authorities should be informed in order to assess the need for evacuation;
- Ensure that appropriate decontamination treatment or testing for exposed or injured personnel is obtained;
- Determine the cause of the incident and make recommendations to prevent the recurrence; and
- Ensure that all required reports have been prepared.

9.4 Medical Emergencies

Any person who becomes ill or injured in the exclusion zone must be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination should be completed and first aid administered prior to transport. First aid should be administered while awaiting an ambulance or paramedics. Any person transporting an injured/exposed person to a clinic or hospital for treatment should take directions to the hospital and

information on the chemical(s) to which they may have been exposed with them.

9.5 Fire or Explosion

In the event of fire or explosion, the local fire department should be summoned immediately. Upon their arrival, the HSO or designated alternate will advise the fire commander of the location, nature and identification of the hazardous materials on-site. If it is safe to do so, site personnel may:

- Use fire fighting equipment available on site; or
- Remove or isolate flammable or other hazardous materials which may contribute to the fire.

9.6 Evacuation Routes

Evacuation routes established by work area locations for this site will be highlighted on a site map and periodically reviewed during the daily safety meetings. As the work areas "float", the evacuation route and map will be altered accordingly, and the new route will be reviewed during the daily safety meetings.

Under extreme emergency conditions, evacuation should be conducted immediately and without regard for equipment. Evacuation notification will be a continuous blast of a vehicle horn, if possible, and/or by verbal/radio communication. Site personnel should:

- Keep upwind of smoke, vapors or spill location.
- Exit through the decontamination corridor if possible.
- If evacuation is not via the decontamination corridor, site personnel should remove contaminated clothing once

they are in a location of safety and leave it near the exclusion zone or in a safe place.

- The HSO will conduct a head count to ensure all personnel have been evacuated safely. The head count will be correlated to the site and/or hot zone entry/exit log.
- In the event that emergency site evacuation is necessary, all personnel are to escape the emergency situation and decontaminate to the maximum extent practical.

9.7 Spill Control Procedures

In the event of a leak or a release, site personnel will:

- Inform their supervisor immediately;
- Locate the source or the spillage and stop the flow if it can be done safely; and
- Begin containment and recovery of the spilled materials.

Equipment will be kept on-site to contain a spill. Spill containment equipment (adsorbent pads and "Speedy Dry") will be stored in the work area and the support zone.

9.8 Emergency Response Protocols

All emergency telephone numbers and a map showing the emergency route to the hospital (Figure 3) will be posted at the decontamination area. In the event of physical injury, the site safety officer or any other qualified person will initiate first-aid and, if necessary, call the Fire Department to dispatch an ambulance. If chemical exposure occurs, a physician will be informed, as specifically as possible, of the chemical(s) to which the person has been exposed and the toxicological properties of the chemical(s). Site evacuation procedures and emergency response protocols will be reviewed with the site personnel prior to site investigation activities.

Although not expected, if a sudden increase of organic vapors occurs during drilling activities, all work will stop and personnel will leave the affected area. The vapor levels will then be monitored by the safety officer wearing appropriate personal protective equipment.

9.9 Emergency Route to Local Hospital

Figure 3 shows the route to Atlantic City Medical Center. Directions from the site to the medical center are as follows:

1. South (left) on Tilton Road to Riverside Drive.
2. East (left) on Riverside Drive to Jimmy Leeds Road.
3. Right on Jimmy Leeds Road to hospital entrance.
4. Left at entrance and follow road to hospital.

10.0 CONFINED SPACE

In general, a confined space is defined as a space or work area not designed or intended for normal human occupancy, having limited means of access and poor natural ventilation, and any structure, including buildings or rooms which have limited means of egress. Examples include tanks, vats, and basements. By their very nature, confined spaces may contain oxygen-deficient atmospheres, flammable atmospheres, and/or toxic atmospheres. Confined space entry is not anticipated at the site. In the event a confined space entry is deemed to be necessary, the health and safety plan will be amended and the requirements for a confined space entry will be followed.

TABLES

LENOX CHINA
A DIVISION OF LENOX, INC.
POMONA, NEW JERSEY

TABLE 1

HEALTH AND SAFETY TRAINING RECORDS

Eder Personnel	Attendance Date 40-Hour Health and Safety Training Course	Attendance Date 8-Hour Health and Safety Training Refresher Course	Attendance Date Supervisors Training	Date of Last Physical	Date of Last Fit Test
M. Ambrosio	06/25/92	11/21/92	--	07/30/92	11/21/92
N. Andrianas	03/28/86	11/21/92	2/27/93	07/14/92	11/21/92
A. Brunelle	09/14/90	11/21/92	2/27/93	11/21/92	11/21/92
J. Barish	02/05/88	11/21/92	2/27/93	09/10/92	--"
B. Battaglia	10/30/92	11/21/92	--	08/27/92	11/21/92
E. Beacon	06/10/88	11/21/92	--	06/09/92	11/21/92
K. Butler	08/27/92	11/21/92	--	07/21/92	11/21/92
J. Bysura ²⁾	--	--	--	--	--
M. Doherty	08/27/92	11/21/92	--	09/03/92	11/21/92
M. Foley	06/19/87	--	6/20/87	--	--
A. Giaimo	10/30/92	11/21/92	--	10/22/92	11/21/92
J. Heaney	06/19/87	11/21/92	06/24/91	12/03/91	11/21/92
J. Kinkela ²⁾	--	--	--	--	--
K. McHale	06/16/89	11/21/92	02/27/93	09/01/92	11/21/92
S. O'Brien	01/15/93	--	--	01/07/93	01/15/93
K. Pasterak	05/14/86	11/26/92	--	12/03/91	07/01/88
B. Pendergast	05/04/90	11/21/92	02/27/93	07/02/92	11/21/92
T. Perotto	10/16/91	10/12/92	--	01/07/93	10/12/92
V. Raykin	05/04/90	11/21/92	02/27/93	08/25/92	11/21/92
K. Savo	03/26/93	--	--	03/18/93	03/26/93
M. Shen	11/04/90	03/26/92	--	06/23/92	03/26/92
J. Valenti	09/14/90	11/21/92	02/27/93	12/10/91	11/21/92

NOTES:

1. To be fit tested prior to conducting field work.
2. Lenox management personnel will attend 40-hour health and safety course before conducting field work.

FIGURES

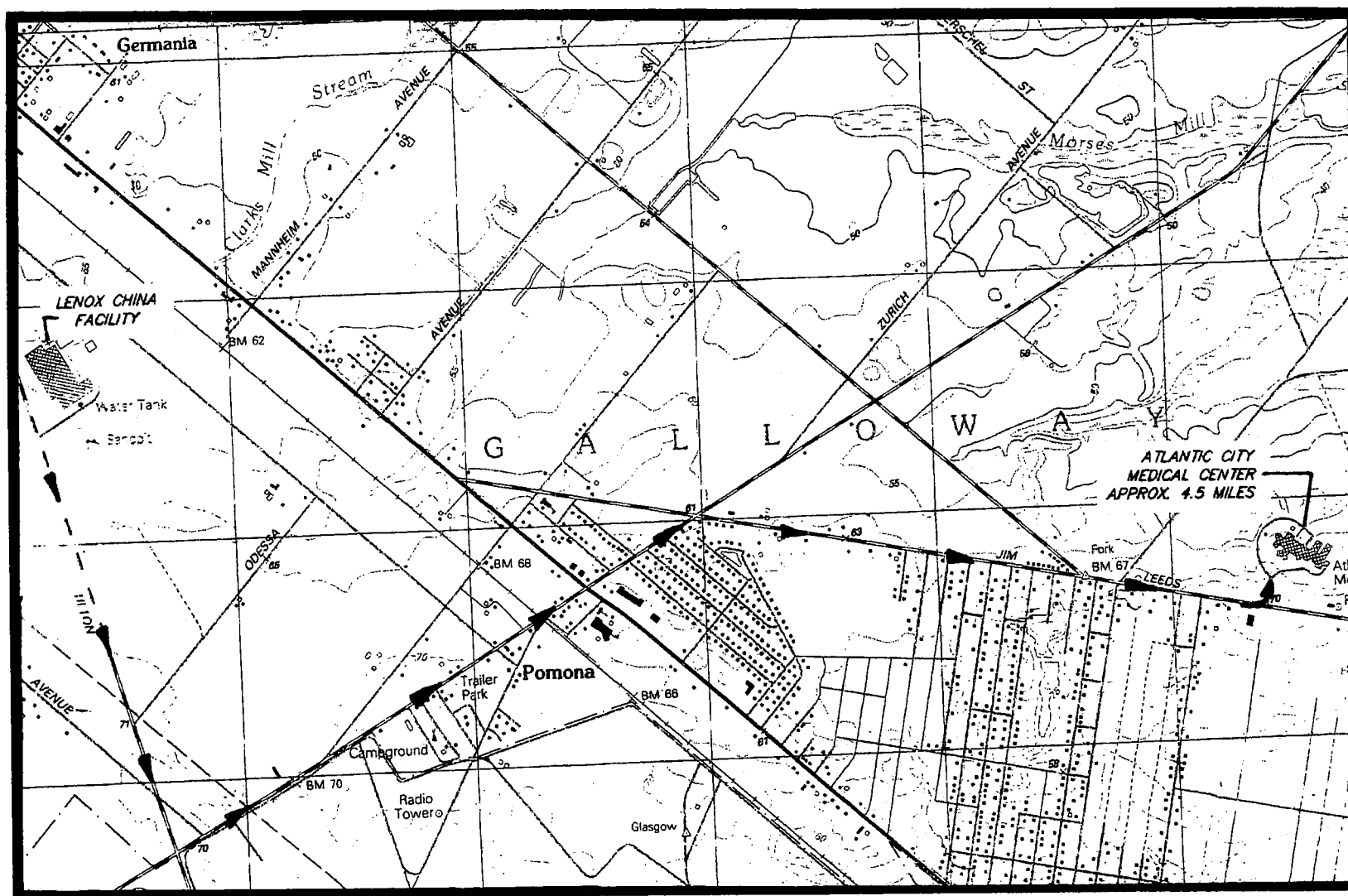
FIGURE 1

LOCATION MAP DRAWING FROM FACILITY BACKGROUND REPORT

FIGURE 2

SITE MAP DRAWING FROM FACILITY BACKGROUND REPORT

LENOX CHINA, INC.
POMONA, NEW JERSEY



ROUTE TO HOSPITAL

APPENDIX A

HEAT AND COLD STRESS CASUALTY PREVENTION PLAN

A. Identification and Treatment

1) Heat Exhaustion

- a) Symptoms: Usually begins with muscular weakness, dizziness, nausea, and a staggering gait. Vomiting is frequent. The bowels may move involuntarily. The victim is very pale, his skin is clammy, and he may perspire profusely. The pulse is weak and fast, his breathing is shallow. He may faint unless he lies down. This may pass, but sometimes it remains and death could occur.
- b) First-Aid: Immediately remove the victim to the Decontamination Zone in a shady or cool area with good air circulation. Remove all protective outer wear. Call a physician. Treat the victim for shock (make him lie down, raise his feet 6-12 inches, loosen all clothing, and allow him to cool off without chilling). If the victim is conscious, it may be helpful to give him sips of a salt water solution (1 teaspoon of salt to 1 glass of water). Transport victim to a medical facility.

2) Heat Stroke

- a) Symptoms: This is the most serious of heat casualties due to the fact that the body excessively overheats. Body temperatures often are between 107°-110°F. First there is often pain in the head, dizziness, nausea, oppression, and a dryness of the skin and mouth. Unconsciousness follows quickly and death is imminent if exposure continues. The attack will usually occur suddenly.

- b) First-Aid: Immediately evacuate the victim to a cool and shady area in the Decontamination Zone. Remove all protective outer wear and all personal clothing. Lay him on his back with the head and shoulders slightly elevated. It is imperative that the body temperature be lowered immediately. This can be accomplished by applying cold wet towels, ice bags, etc., to the head. Sponge off the bare skin with cool water or rubbing alcohol, if available, or even place him in a tub of cool water. The main objective is to cool him without chilling him. Give no stimulants. Transport the victim to a medical facility as soon as possible.

B. Prevention of Heat Stress

- 1) One of the major causes of heat casualties is the depletion of body fluids. On the site there will be plenty of fluids available. Personnel should replace water and salts loss from sweating. Salts can be replaced by either a 0.1% salt solution, more heavily salted foods, or commercial mixes such as Gatorade. The commercial mixes are advised for personnel on low sodium diets.
- 3) A work/rest guideline will be implemented for personnel required to wear Level B protection, if this situation arises. This guideline is as follows:

Ambient Temperatures

Above 90°F
80°-90°F
70°-80°F
60°-70°F
50°-60°F
40°-50°F
30°-40°F
Below 30°F

Maximum Wearing Time

1/2 hour
1 hour
2 hours
3 hours
4 hours
5 hours
6 hours
8 hours

A sufficient period will be allowed for personnel to "cool down". This may require shifts of workers during operations.

COLD STRESS CASUALTY PREVENTION PLAN (Table A-1)

1. Frostbite

Symptoms: This is the most common injury resulting from exposure to cold. The extremities of the body are most often affected. The signs of frostbite are:

- The skin turns white or grayish-yellow.
- Pain is sometimes felt early but subsides later, often there is no pain.
- The affected part feels intensely cold and numb.

2. Hypothermia

Symptoms: Hypothermia is characterized by shivering, numbness, drowsiness, muscular weakness and a low internal body temperature when the body feels warm externally. This can lead to unconsciousness and death.

With both frostbite and hypothermia, the affected areas need to be warmed quickly. This is best done by immersing in warm, not hot water. In all cases, seek medical assistance.

To prevent these effects from occurring, persons working in the cold should wear adequate clothing and reduce the time spent in the cold.

Recommended limits for properly clothed workers for periods of work at temperatures below freezing are shown in Table A-1.

LENOX CHINA
A DIVISION OF LENOX, INC.
POMONA, NEW JERSEY

TABLE A-1

THRESHOLD LIMIT VALUES WORK/WARM-UP SCHEDULE*

*C (approx.)	*F	Maximum Work Period	No. of Breaks	Maximum Work Period	No. of Breaks	Maximum Work Period	No. of Breaks	Maximum Work Period	No. of Breaks	Maximum Work Period	No. of Breaks
1. -26 to -28	-15 to -19	(normal breaks)	1	(normal breaks)	1	75 minutes	2	55 minutes	3	40 minutes	4
2. -29 to -31	-20 to -24	(normal breaks)	1	75 minutes	2	55 minutes	3	40 minutes	4	30 minutes	5
3. -32 to -34	-25 to -29	75 minutes	2	55 minutes	3	40 minutes	4	30 minutes	5	Non emergency work should cease	
4. -35 to -37	-30 to -34	55 minutes	3	40 minutes	4	30 minutes	5	Non emergency work should cease			
5. -38 to -39	-35 to -39	40 minutes	4	30 minutes	5	Non emergency work should cease					
6. -40 to -42	-40 to -44	30 minutes	5	Non emergency work should cease							
7. -43 & below	-45 & below	Non emergency work should cease									

NOTES:

- Schedule applies to moderate to heavy work activity with warm-up breaks of ten minutes in a warm location. For light-to-moderate work (limited physical movement): apply the schedule one step lower. For example, at -30°F with no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period (Step 5).
- The following is suggested as a guide for estimating wind velocity if accurate information is not available: 5 mph: light flag moves; 10 mph: light flag fully extended; 15 mph: raises newspaper sheet; 20 mph: blowing and drifting snow.
- If only the wind chill cooling rate is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be: 1) special warm-up breaks should be initiated at a wind chill of about 1,750 W/m²; 2) all non-emergency work should have ceased at or before a wind chill of 2,250 W/m². In general, the warm-up schedule provided above slightly under-compensates for the wind at the warmer temperatures, assuming acclimatization and clothing appropriate for winter work. On the other hand, the chart slightly over-compensates for the actual temperatures in the colder ranges, since windy conditions rarely prevail at extremely low temperatures.

* Adopted from Occupational Health & Safety Division, Saskatchewan Department of Labor.

APPENDIX B

CHEMICAL DATA SHEETS

T4940 -05
EFFECTIVE: 05/01/89
ISSUED: 05/18/91

TRICHLOROETHYLENE

SECTION I - PRODUCT IDENTIFICATION

PRODUCT NAME: TRICHLOROETHYLENE
COMMON SYNONYMS: TRICHLOROETHENE; ETHINYL TRICHLORIDE; ACETYLENE
TRICHLORIDE; TCE
CHEMICAL FAMILY: CHLORINATED HYDROCARBONS
FORMULA: C2HCL3
FORMULA WT.: 131.40
CAS NO.: 79-01-6
NIOSH/RTECS NO.: KX4550000
PRODUCT USE: LABORATORY REAGENT
PRODUCT CODES: 9458, 9474, 9473, 5376, 9455, 9464, 9454

(PHAZ) Primary Hazards:

PRECAUTIONARY LABELING

BAKER SAF-T-DATA* SYSTEM

HEALTH	-	3	SEVERE (CANCER CAUSING)
FLAMMABILITY	-	1	SLIGHT
REACTIVITY	-	2	MODERATE
CONTACT	-	2	MODERATE

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

U.S. PRECAUTIONARY LABELING

WARNING

CAUSES IRRITATION. HARMFUL IF SWALLOWED OR INHALED. HEAT MAY CAUSE
DECOMPOSITION AND GENERATE CORROSIVE VAPORS. NOTE: REPORTED AS
CAUSING CANCER
IN LABORATORY ANIMALS. EXERCISE DUE CARE.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING. DO NOT BREATHE VAPOR.
KEEP IN
TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE VENTILATION. WASH
THOROUGHLY
AFTER HANDLING. IN CASE OF SPILL, SOAK UP WITH SAND OR EARTH.

INTERNATIONAL LABELING

HARMFUL BY INHALATION AND IF SWALLOWED. POSSIBLE RISKS OF IRREVERSIBLE EFFECTS.

KEEP OUT OF REACH OF CHILDREN. AVOID CONTACT WITH EYES.

SAF-T-DATA* STORAGE COLOR CODE: BLUE (HEALTH)

(COMP) Components:

=====

SECTION II - COMPONENTS

=====

COMPONENT ACGIH/TLV	CAS NO.	WEIGHT %	OSHA/PEL
TRICHLOROETHYLENE 50 PPM	79-01-6	99-100	50 PPM

(PHYS) Physical Properties:

=====

SECTION III - PHYSICAL DATA

=====

BOILING POINT: 87 C (188 F)
58
(AT 760 MM HG)

VAPOR PRESSURE (MMHG):

(20 C)

MELTING POINT: -73 C (-99 F)
4.53
(AT 760 MM HG)

VAPOR DENSITY (AIR=1):

SPECIFIC GRAVITY: 1.46
(H2O=1)

EVAPORATION RATE: N/A

SOLUBILITY(H2O): SLIGHT (0.1-1%)
100

% VOLATILES BY VOLUME:

(21 C)

PH: N/A

ODOR THRESHOLD (P.P.M.): N/A

PHYSICAL STATE: LIQUID

COEFFICIENT WATER/OIL DISTRIBUTION: N/A

APPEARANCE & ODOR: CLEAR, COLORLESS LIQUID. CHLOROFORM-LIKE ODOR.

(FHAZ) — Fire Hazards:

=====

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

=====

FLASH POINT (CLOSED CUP): N/A
2-1-0

NEPA 704M RATING:

AUTOIGNITION TEMPERATURE: N/A

FLAMMABLE LIMITS: UPPER - 10.5 % LOWER - 8.0 %

FIRE EXTINGUISHING MEDIA

USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND
SELF-CONTAINED

BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE
PRESSURE

MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT
RISK. USE

WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS

GIVES OFF FLAMMABLE VAPORS. VAPORS MAY FORM EXPLOSIVE MIXTURE
WITH AIR.

CLOSED CONTAINERS EXPOSED TO HEAT MAY EXPLODE. CONTACT WITH
STRONG

OXIDIZERS MAY CAUSE FIRE. CONCENTRATED VAPORS CAN BE IGNITED BY
HIGH

INTENSITY HEAT SOURCE.

TOXIC GASES PRODUCED

HYDROGEN CHLORIDE, PHOSGENE, CARBON MONOXIDE, CARBON DIOXIDE

EXPLOSION DATA-SENSITIVITY TO MECHANICAL IMPACT

NONE IDENTIFIED.

EXPLOSION DATA-SENSITIVITY TO STATIC DISCHARGE

NONE IDENTIFIED.

(HAZH) Health Hazards:

=====

SECTION V - HEALTH HAZARD DATA

=====

THRESHOLD LIMIT VALUE (TLV/TWA): 270 MG/M3 (50 PPM)

SHORT-TERM EXPOSURE LIMIT (STEL): 1080 MG/M3 (200 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL):

(100 PPM)

TOXICITY OF COMPONENTS

ORAL RAT LD50 FOR TRICHLOROETHYLENE

3670 MG/KG

INTRAPERITONEAL MOUSE LD50 FOR TRICHLOROETHYLENE

1831 MG/KG

INTRAVENOUS MOUSE LD50 FOR TRICHLOROETHYLENE

34 MG/KG

INHALATION-4HR MOUSE LC50 FOR TRICHLOROETHYLENE

8450 PPM

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG:
NO

CARCINOGENICITY

TESTS ON LABORATORY ANIMALS INDICATE MATERIAL MAY BE
CARCINOGENIC.

REPRODUCTIVE EFFECTS

TESTS ON LABORATORY ANIMALS INDICATE MATERIAL MAY BE MUTAGENIC.

EFFECTS OF OVEREXPOSURE

INHALATION: HEADACHE, NAUSEA, VOMITING, DIZZINESS,
NARCOSIS,
WEAKNESS, FATIGUE, IRRITATION OF UPPER
RESPIRATORY TRACT,
NUMBNESS OF LIMBS, CENTRAL NERVOUS SYSTEM
DEPRESSION,
PULMONARY EDEMA, UNCONSCIOUSNESS

SKIN CONTACT: IRRITATION, PROLONGED CONTACT MAY CAUSE
DERMATITIS

EYE CONTACT: IRRITATION

SKIN ABSORPTION: NONE IDENTIFIED

INGESTION: NAUSEA, HEADACHES, DIZZINESS, CONFUSION,
JAUNDICE,
GASTROINTESTINAL IRRITATION, CENTRAL NERVOUS
SYSTEM
DEPRESSION, UNCONSCIOUSNESS

CHRONIC EFFECTS: DAMAGE TO LIVER, KIDNEYS, BLOOD, AND CENTRAL
NERVOUS
SYSTEM DEPRESSION

TARGET ORGANS

RESPIRATORY SYSTEM, LUNGS, KIDNEYS, LIVER, BLOOD, HEART,
CENTRAL NERVOUS
SYSTEM, SKIN

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

LIVER OR KIDNEY DISORDERS, LUNG DISEASE, CENTRAL NERVOUS SYSTEM
DISORDERS

PRIMARY ROUTES OF ENTRY

INHALATION, INGESTION, EYE CONTACT, SKIN CONTACT

(AID) First Aid:

=====

EMERGENCY AND FIRST AID PROCEDURES

=====

INGESTION: CALL A PHYSICIAN. IF SWALLOWED, DO NOT INDUCE
VOMITING. IF CONSCIOUS, GIVE LARGE AMOUNTS OF WATER.

INHALATION: IF INHALED, REMOVE TO FRESH AIR. IF NOT
BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS
DIFFICULT, GIVE OXYGEN.

SKIN CONTACT: IN CASE OF CONTACT, IMMEDIATELY FLUSH SKIN WITH
PLENTY OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING
CONTAMINATED CLOTHING AND SHOES. WASH CLOTHING BEFORE RE-USE.

EYE CONTACT: IN CASE OF EYE CONTACT, IMMEDIATELY FLUSH WITH
PLENTY OF WATER FOR AT LEAST 15 MINUTES.

(REGS) Regulations:

SARA/TITLE III HAZARD CATEGORIES AND LISTS

ACUTE: YES CHRONIC: YES FLAMMABILITY: NO PRESSURE: NO REACTIVITY:
NO

EXTREMELY HAZARDOUS SUBSTANCE: NO

CERCLA HAZARDOUS SUBSTANCE: YES CONTAINS TRICHLOROETHYLENE (RQ
= 1000 LBS)

SARA 313 TOXIC CHEMICALS: YES CONTAINS TRICHLOROETHYLENE
GENERIC CLASS: C03

TSCA INVENTORY: YES

STATE LISTS: FOR PRODUCTS SOLD IN THE STATE OF CALIFORNIA, THE
STATE REQUIRES

THAT WE PROVIDE TO USERS AND THEIR EMPLOYEES THE FOLLOWING MESSAGE:
WARNING:

THIS PRODUCT IS A CHEMICAL KNOWN TO THE STATE OF CALIFORNIA TO
CAUSE CANCER.

(HAZR) Hazardous Reactions:

=====

SECTION VI - REACTIVITY DATA

=====

STABILITY: STABLE
OCCUR

HAZARDOUS POLYMERIZATION: MAY

CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION,
LIGHT

INCOMPATIBLES: CHEMICALLY ACTIVE METALS, STRONG BASES,
STRONG
OXIDIZING AGENTS, POWDERED METALS

DECOMPOSITION PRODUCTS: HYDROGEN CHLORIDE, PHOSGENE, CARBON
MONOXIDE, CARBON
DIOXIDE

(SPIL) Spillage Disposal:

=====

SECTION VII - SPILL & DISPOSAL PROCEDURES

=====

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE
CLOTHING. STOP

LEAK IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE
VAPORS.

TAKE UP WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL
AND PLACE

INTO CONTAINER FOR LATER DISPOSAL. FLUSH SPILL AREA WITH
WATER.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND
LOCAL
ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: U228 (TOXIC WASTE)

(EQP) Protective Equipment:

=====

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

=====

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO
MEET TLV

REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE
CONCENTRATIONS ABOVE 50 CONCENTRATION EXCEEDS TLV. AT
IS ADVISED. PPM, A SELF-CONTAINED BREATHING APPARATUS

EYE/SKIN PROTECTION: SAFETY GOGGLES AND FACE SHIELD, UNIFORM,
PROTECTIVE SUIT, NEOPRENE GLOVES ARE RECOMMENDED.

(STOR) Storage Procedures:

=====

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

=====

SAF-T-DATA* STORAGE COLOR CODE: BLUE (HEALTH)

STORAGE REQUIREMENTS

KEEP CONTAINER TIGHTLY CLOSED. STORE IN SECURE POISON AREA.
STORE IN A
COOL, DRY, WELL-VENTILATED AREA. ISOLATE FROM INCOMPATIBLE
MATERIALS.

(TRAN) Transportation Information:

=====

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

=====

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME: TRICHLOROETHYLENE (AIR ONLY)
HAZARD CLASS: ORM-A
UN/NA: UN1710 REPORTABLE QUANTITY: 1000 LBS.
LABELS: NONE
REGULATORY REFERENCES: 49CFR 172.101; 173.500; 173.510

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME: TRICHLOROETHYLENE
HAZARD CLASS: 6.1 I.M.O. PAGE:
6243
UN: UN1710 MARINE POLLUTANTS: NO PACKAGING
GROUP: III
LABELS: HARMFUL - STOW AWAY FROM FOOD STUFFS
REGULATORY REFERENCES: 49CFR 172.102; PART 176; IMO

AIR (I.C.A.O.)

PROPER SHIPPING NAME: TRICHLOROETHYLENE

HAZARD CLASS: 6.1

UN: UN1710

PACKAGING

GROUP: III

LABELS: HARMFUL - STOW AWAY FROM FOOD STUFFS

REGULATORY REFERENCES: 49CFR 172.101; 173.6; PART 175; ICAO/IATA

U.S. CUSTOMS HARMONIZATION NUMBER: 29032200008

N/A = NOT APPLICABLE OR NOT AVAILABLE

N/E = NOT ESTABLISHED

(DISC) Disclaimer:

THE INFORMATION IN THIS MATERIAL SAFETY DATA SHEET MEETS THE REQUIREMENTS OF THE UNITED STATES OCCUPATIONAL SAFETY AND HEALTH ACT AND

REGULATIONS PROMULGATED THEREUNDER (29 CFR 1910.1200 ET. SEQ.) AND THE

CANADIAN WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM. THIS DOCUMENT

IS INTENDED ONLY AS A GUIDE TO THE APPROPRIATE PRECAUTIONARY HANDLING OF

THE MATERIAL BY A PERSON TRAINED IN, OR SUPERVISED BY A PERSON TRAINED

IN, CHEMICAL HANDLING. THE USER IS RESPONSIBLE FOR DETERMINING THE

PRECAUTIONS AND DANGERS OF THIS CHEMICAL FOR HIS OR HER PARTICULAR

APPLICATION. DEPENDING ON USAGE, PROTECTIVE CLOTHING INCLUDING EYE AND

FACE GUARDS AND RESPIRATORS MUST BE USED TO AVOID CONTACT WITH MATERIAL

OR BREATHING CHEMICAL VAPORS/FUMES.

EXPOSURE TO THIS PRODUCT MAY HAVE SERIOUS ADVERSE HEALTH EFFECTS. THIS

CHEMICAL MAY INTERACT WITH OTHER SUBSTANCES. SINCE THE POTENTIAL USES

ARE SO VARIED, BAKER CANNOT WARN OF ALL OF THE POTENTIAL DANGERS OF USE

OR INTERACTION WITH OTHER CHEMICALS OR MATERIALS. BAKER WARRANTS THAT

THE CHEMICAL MEETS THE SPECIFICATIONS SET FORTH ON THE LABEL.

BAKER DISCLAIMS ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED WITH REGARD

TO THE PRODUCT SUPPLIED HEREUNDER, ITS MERCHANTABILITY OR ITS FITNESS

FOR A PARTICULAR PURPOSE.

THE USER SHOULD RECOGNIZE THAT THIS PRODUCT CAN CAUSE SEVERE INJURY AND

EVEN DEATH, ESPECIALLY IF IMPROPERLY HANDLED OR THE KNOWN DANGERS OF USE

ARE NOT HEEDDED. READ ALL PRECAUTIONARY INFORMATION. AS NEW DOCUMENTED

GENERAL SAFETY INFORMATION BECOMES AVAILABLE, BAKER WILL PERIODICALLY

REVISE THIS MATERIAL SAFETY DATA SHEET.

NOTE: CHEMTREC, CANUTEC, AND NATIONAL RESPONSE CENTER EMERGENCY
TELEPHONE

NUMBERS ARE TO BE USED ONLY IN THE EVENT OF CHEMICAL EMERGENCIES
INVOLVING

A SPILL, LEAK, FIRE, EXPOSURE, OR ACCIDENT INVOLVING CHEMICALS. ALL

NON-EMERGENCY QUESTIONS SHOULD BE DIRECTED TO CUSTOMER SERVICE
(1-800-JTBAKER) FOR ASSISTANCE.

COPYRIGHT 1991 J.T.BAKER INC.

* TRADEMARKS OF J.T.BAKER INC.

===

APPROVED BY QUALITY ASSURANCE DEPARTMENT.

L2347 -05
EFFECTIVE: 05/01/89
ISSUED: 05/18/91

LEAD, GRANULAR OR SHOT

SECTION I - PRODUCT IDENTIFICATION

PRODUCT NAME: LEAD, GRANULAR OR SHOT
COMMON SYNONYMS: C.I. 77575
CHEMICAL FAMILY: METALS
FORMULA: PB
FORMULA WT.: 207.20
CAS NO.: 7439-92-1
NIOSH/RTECS NO.: OF7525000
PRODUCT USE: LABORATORY REAGENT
PRODUCT CODES: 2256,2266,4996

(PHAZ) Primary Hazards:

PRECAUTIONARY LABELING

BAKER SAF-T-DATA* SYSTEM

HEALTH	-	3	SEVERE (LIFE)
FLAMMABILITY	-	0	NONE
REACTIVITY	-	0	NONE
CONTACT	-	1	SLIGHT

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES

U.S. PRECAUTIONARY LABELING

POISON DANGER

HARMFUL IF INHALED. MAY CAUSE IRRITATION. MAY BE FATAL IF SWALLOWED.
EXCEPTIONAL HEALTH HAZARD: READ MATERIAL SAFETY DATA SHEET.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING. DO NOT BREATHE DUST.
KEEP IN
TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY
AFTER HANDLING.

INTERNATIONAL LABELING

AVOID CONTACT WITH EYES. AFTER CONTACT WITH SKIN, WASH IMMEDIATELY WITH
PLENTY OF WATER. KEEP CONTAINER TIGHTLY CLOSED.

SAF-T-DATA* STORAGE COLOR CODE: BLUE (HEALTH)

(COMP) Components:

SECTION II - COMPONENTS

COMPONENT ACGIH/TLV	CAS NO.	WEIGHT %	OSHA/PEL
LEAD 0.15 MG/M3	7439-92-1	87-99	0.05 MG/M3
ANTIMONY 0.5 MG/M3	7440-36-0	0.5-5	0.5 MG/M3
ARSENIC 0.2 MG/M3	7440-38-2	.01-.5	0.01 MG/M3

(PHYS) Physical Properties:

SECTION III - PHYSICAL DATA

BOILING POINT: 1744 C (3171 F)
N/A
(AT 760 MM HG)

VAPOR PRESSURE (MMHG):

MELTING POINT: 327 C (620 F)
N/A
(AT 760 MM HG)

VAPOR DENSITY (AIR=1):

SPECIFIC GRAVITY: 11.3
(H2O=1)

EVAPORATION RATE: N/A

SOLUBILITY (H2O): NEGLIGIBLE (<0.1%)
0

% VOLATILES BY VOLUME:
(21 C)

PH: N/A

ODOR THRESHOLD (P.P.M.): N/A

PHYSICAL STATE: SOLID

COEFFICIENT WATER/OIL DISTRIBUTION: N/A

APPEARANCE & ODOR: WHITE TO GRAY METAL. ODORLESS.

(FHAZ) Fire Hazards:

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

=====

FLASH POINT (CLOSED CUP): N/A

AUTOIGNITION TEMPERATURE: N/A

FLAMMABLE LIMITS: UPPER - N/A LOWER - N/A

FIRE EXTINGUISHING MEDIA

USE DRY CHEMICAL OR CARBON DIOXIDE. DO NOT USE WATER.

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED

BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE.

UNUSUAL FIRE & EXPLOSION HAZARDS

NONE IDENTIFIED.

TOXIC GASES PRODUCED

LEAD FUMES

EXPLOSION DATA-SENSITIVITY TO MECHANICAL IMPACT

NONE IDENTIFIED.

EXPLOSION DATA-SENSITIVITY TO STATIC DISCHARGE

NONE IDENTIFIED.

(HAZH) Health Hazards:

=====

SECTION V - HEALTH HAZARD DATA

=====

THRESHOLD LIMIT VALUE (TLV/TWA): 0.15 MG/M3

TLV IS FOR LEAD, INORGANIC DUSTS AND FUMES, AS PB.

SHORT-TERM EXPOSURE LIMIT (STEL): NOT ESTABLISHED

PERMISSIBLE EXPOSURE LIMIT (PEL): 0.05 MG/M3

PEL IS FOR LEAD, INORGANIC DUSTS AND FUMES, AS PB.

TOXICITY OF COMPONENTS

ORAL RAT LD50 FOR ARSENIC

15.1 MG/KG

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: YES OSHA REG: YES

CARCINOGENICITY

NONE IDENTIFIED.

REPRODUCTIVE EFFECTS

NONE IDENTIFIED.

EFFECTS OF OVEREXPOSURE

INHALATION: IRRITATION OF UPPER RESPIRATORY TRACT, MAY
CAUSE ANEMIA, NAUSEA, VOMITING, GASTROINTESTINAL IRRITATION,
DIARRHEA, WEAKNESS, WEIGHT LOSS, CONVULSIONS

SKIN CONTACT: IRRITATION

EYE CONTACT: IRRITATION

SKIN ABSORPTION: NONE IDENTIFIED

INGESTION: ANEMIA, NAUSEA, VOMITING, GASTROINTESTINAL
IRRITATION, PARALYSIS, CENTRAL NERVOUS SYSTEM DEPRESSION

CHRONIC EFFECTS: DAMAGE TO BLOOD FORMING TISSUE, ANEMIA, KIDNEY
DAMAGE, BLURRED VISION, LEAD BUILD-UP IN THE CENTRAL
NERVOUS SYSTEM

TARGET ORGANS

GI TRACT, CENTRAL NERVOUS SYSTEM, KIDNEYS, BLOOD, GINGIVAL
TISSUE

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

KIDNEY DISORDERS, LIVER DISORDERS, CENTRAL NERVOUS SYSTEM
DISORDERS

PRIMARY ROUTES OF ENTRY

INGESTION, INHALATION, EYE CONTACT, SKIN CONTACT

(AID) First Aid:

EMERGENCY AND FIRST AID PROCEDURES

INGESTION: CALL A PHYSICIAN. IF SWALLOWED, IF CONSCIOUS,
IMMEDIATELY INDUCE VOMITING.

INHALATION: IF INHALED IN LARGE AMOUNTS, MOVE EXPOSED PERSON
TO FRESH AIR. GET MEDICAL ATTENTION.

SKIN CONTACT: IN CASE OF CONTACT, IMMEDIATELY WASH SKIN WITH
PLENTY OF

SOAP AND WATER FOR AT LEAST 15 MINUTES.

EYE CONTACT: IN CASE OF EYE CONTACT, IMMEDIATELY FLUSH WITH
PLENTY OF

WATER FOR AT LEAST 15 MINUTES. GET MEDICAL
ATTENTION.

(REGS) Regulations:

=====

SARA/TITLE III HAZARD CATEGORIES AND LISTS

=====

ACUTE: YES CHRONIC: YES FLAMMABILITY: NO PRESSURE: NO REACTIVITY:
NO

EXTREMELY HAZARDOUS SUBSTANCE: NO

CERCLA HAZARDOUS SUBSTANCE: YES CONTAINS LEAD (RQ = 1 LB) AND
ANTIMONY (RQ

= 5000LBS) AND ARSENIC (RQ = 1

LB)

SARA 313 TOXIC CHEMICALS: YES CONTAINS ANTIMONY, ARSENIC, AND
LEAD

GENERIC CLASS:

C15

TSCA INVENTORY: YES

STATE LISTS: FOR PRODUCTS SOLD IN THE STATE OF CALIFORNIA, THE
STATE REQUIRES

THAT WE PROVIDE TO USERS AND THEIR EMPLOYEES THE FOLLOWING MESSAGE:
WARNING:

THIS PRODUCT IS A CHEMICAL KNOWN TO THE STATE OF CALIFORNIA TO
CAUSE BIRTH

DEFECTS OR OTHER REPRODUCTIVE HARM.

(HAZR) Hazardous Reactions:

=====

SECTION VI - REACTIVITY DATA

=====

STABILITY: STABLE
NOT OCCUR

HAZARDOUS POLYMERIZATION: WILL

CONDITIONS TO AVOID: NONE DOCUMENTED

INCOMPATIBLES: STRONG OXIDIZING AGENTS, POTASSIUM, SODIUM,
STRONG

ACIDS, STRONG BASES, STRONG REDUCING AGENTS

DECOMPOSITION PRODUCTS: LEAD FUMES

(SPIL) Spillage Disposal:

=====

SECTION VII - SPILL & DISPOSAL PROCEDURES

=====

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING. WITH CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D008 (EP TOXIC WASTE)

(EQP) Protective Equipment:

=====

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

=====

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: NONE REQUIRED WHERE ADEQUATE VENTILATION CONDITIONS EXIST. IF AIRBORNE CONCENTRATION EXCEEDS TLV, A HIGH-EFFICIENCY PARTICULATE RESPIRATOR IS RECOMMENDED. IF CONCENTRATION EXCEEDS CAPACITY OF RESPIRATOR, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GOGGLES, UNIFORM, PROPER GLOVES ARE RECOMMENDED.

(STOR) Storage Procedures:

=====

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

=====

SAF-T-DATA* STORAGE COLOR CODE: BLUE (HEALTH)

STORAGE REQUIREMENTS

KEEP CONTAINER TIGHTLY CLOSED. SUITABLE FOR ANY GENERAL
CHEMICAL STORAGE
AREA. ISOLATE FROM INCOMPATIBLE MATERIALS.

(TRAN) Transportation Information:

=====

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

=====

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME: CHEMICALS, N.O.S. (NON-REGULATED)

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME: CHEMICALS, N.O.S. (NON-REGULATED)
MARINE POLLUTANTS: NO

AIR (I.C.A.O.)

PROPER SHIPPING NAME: CHEMICALS, N.O.S. (NON-REGULATED)

U.S. CUSTOMS HARMONIZATION NUMBER: 78042000009

N/A = NOT APPLICABLE OR NOT AVAILABLE

N/E = NOT ESTABLISHED

(DISC) Disclaimer:

THE INFORMATION IN THIS MATERIAL SAFETY DATA SHEET MEETS THE
REQUIREMENTS OF THE UNITED STATES OCCUPATIONAL SAFETY AND HEALTH
ACT AND
REGULATIONS PROMULGATED THEREUNDER (29 CFR 1910.1200 ET. SEQ.) AND
THE
CANADIAN WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM. THIS
DOCUMENT
IS INTENDED ONLY AS A GUIDE TO THE APPROPRIATE PRECAUTIONARY
HANDLING OF
THE MATERIAL BY A PERSON TRAINED IN, OR SUPERVISED BY A PERSON
TRAINED
IN, CHEMICAL HANDLING. THE USER IS RESPONSIBLE FOR DETERMINING THE
PRECAUTIONS AND DANGERS OF THIS CHEMICAL FOR HIS OR HER PARTICULAR
APPLICATION. DEPENDING ON USAGE, PROTECTIVE CLOTHING INCLUDING EYE
AND
FACE GUARDS AND RESPIRATORS MUST BE USED TO AVOID CONTACT WITH
MATERIAL
OR BREATHING CHEMICAL VAPORS/FUMES.

EXPOSURE TO THIS PRODUCT MAY HAVE SERIOUS ADVERSE HEALTH EFFECTS. THIS CHEMICAL MAY INTERACT WITH OTHER SUBSTANCES. SINCE THE POTENTIAL USES ARE SO VARIED, BAKER CANNOT WARN OF ALL OF THE POTENTIAL DANGERS OF USE OR INTERACTION WITH OTHER CHEMICALS OR MATERIALS. BAKER WARRANTS THAT THE CHEMICAL MEETS THE SPECIFICATIONS SET FORTH ON THE LABEL. BAKER DISCLAIMS ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED WITH REGARD TO THE PRODUCT SUPPLIED HEREUNDER, ITS MERCHANTABILITY OR ITS FITNESS FOR A PARTICULAR PURPOSE. THE USER SHOULD RECOGNIZE THAT THIS PRODUCT CAN CAUSE SEVERE INJURY AND EVEN DEATH, ESPECIALLY IF IMPROPERLY HANDLED OR THE KNOWN DANGERS OF USE ARE NOT HEEDDED. READ ALL PRECAUTIONARY INFORMATION. AS NEW DOCUMENTED GENERAL SAFETY INFORMATION BECOMES AVAILABLE, BAKER WILL PERIODICALLY REVISE THIS MATERIAL SAFETY DATA SHEET. NOTE: CHEMTREC, CANUTEC, AND NATIONAL RESPONSE CENTER EMERGENCY TELEPHONE NUMBERS ARE TO BE USED ONLY IN THE EVENT OF CHEMICAL EMERGENCIES INVOLVING A SPILL, LEAK, FIRE, EXPOSURE, OR ACCIDENT INVOLVING CHEMICALS. ALL NON-EMERGENCY QUESTIONS SHOULD BE DIRECTED TO CUSTOMER SERVICE (1-800-JTBAKER) FOR ASSISTANCE.

COPYRIGHT 1991 J.T.BAKER INC.
* TRADEMARKS OF J.T.BAKER INC.

===
APPROVED BY QUALITY ASSURANCE DEPARTMENT.

CIS (Version 5.0)

22-MAR-1993 11:44:53.26

Welcome to
The Chemical Information System
as provided by
CIS, Inc.

BAKER (Version 5.00/2.11 January, 1993)

(\$95/Hr.)

Latest Database Update: January 1993 - 1,752 Entries Total

BAKER Accession Number 10798

17500 M05

IRON

EFFECTIVE: 03/09/92

ISSUED: 12/30/92

SECTION I - PRODUCT IDENTIFICATION

PRODUCT NAME: IRON

COMMON SYNONYMS: METALLIC IRON; ELEMENTAL IRON; STEEL

CHEMICAL FAMILY: METALS

FORMULA: FE

FORMULA WT.: 55.85

CAS NO.: 7439-89-6

NIOSH/RTECS NO.: N/A

PRODUCT USE: LABORATORY REAGENT

PRODUCT CODES: 2234, 2230

PRECAUTIONARY LABELING

BAKER SAF-T-DATA* SYSTEM

HEALTH	-	1	SLIGHT
FLAMMABILITY	-	0	NONE
REACTIVITY	-	1	SLIGHT
CONTACT	-	0	NONE

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES; LAB COAT

U.S. PRECAUTIONARY LABELING

CAUTION

CAUSES EYE IRRITATION. MAY BE HARMFUL IF INHALED.

DURING USE AVOID CONTACT WITH EYES, SKIN, CLOTHING. WASH THOROUGHLY AFTER HANDLING. WHEN NOT IN USE KEEP IN TIGHTLY CLOSED CONTAINER.

INTERNATIONAL LABELING

AVOID CONTACT WITH EYES. AFTER CONTACT WITH SKIN, WASH IMMEDIATELY WITH PLENTY OF WATER. KEEP CONTAINER TIGHTLY CLOSED.

SAF-T-DATA* STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

=====

SECTION II - COMPONENTS

=====

COMPONENT	CAS NO.	WEIGHT %	OSHA/PEL	ACGIH/TLV
IRON	7439-89-6	90-100	N/E	N/E

=====

=====

SECTION III - PHYSICAL DATA

=====

BOILING POINT: 2750 C (4982 F) (AT 760 MM HG)	VAPOR PRESSURE (MMHG): N/A
MELTING POINT: 1535 C (2795 F) (AT 760 MM HG)	VAPOR DENSITY (AIR=1): N/A
SPECIFIC GRAVITY: 7.87 (H2O=1)	EVAPORATION RATE: N/A
SOLUBILITY (H2O): NEGLIGIBLE (<0.1%)	% VOLATILES BY VOLUME: 0 (21 C)
PH: N/A	
ODOR THRESHOLD (P.P.M.): N/A	PHYSICAL STATE: SOLID
COEFFICIENT WATER/OIL DISTRIBUTION: N/A	
APPEARANCE & ODOR: GRAY CRYSTALLINE CHIPS.	

=====

=====

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

=====

FLASH POINT (CLOSED CUP): N/A

AUTOIGNITION TEMPERATURE: N/A

FLAMMABLE LIMITS: UPPER - N/A LOWER - N/A

FIRE EXTINGUISHING MEDIA

=====

USE POWDERED GRAPHITE, POWDERED SALT, OR POWDERED LIMESTONE. DO NOT USE
WATER, CARBON DIOXIDE, OR DRY CHEMICAL.

SPECIAL FIRE-FIGHTING PROCEDURES

=====

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED
BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE
MODE.

UNUSUAL FIRE & EXPLOSION HAZARDS

=====

DUST MAY FORM EXPLOSIVE MIXTURE WITH AIR.

TOXIC GASES PRODUCED

=====

NONE IDENTIFIED

EXPLOSION DATA-SENSITIVITY TO MECHANICAL IMPACT

=====

NONE IDENTIFIED.

EXPLOSION DATA-SENSITIVITY TO STATIC DISCHARGE

=====

NONE IDENTIFIED.

=====

SECTION V - HEALTH HAZARD DATA

=====

THRESHOLD LIMIT VALUE (TLV/TWA): NOT ESTABLISHED
SHORT-TERM EXPOSURE LIMIT (STEL): NOT ESTABLISHED
PERMISSIBLE EXPOSURE LIMIT (PEL): NOT ESTABLISHED

TOXICITY OF COMPONENTS

NO INFORMATION IS AVAILABLE

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

CARCINOGENICITY

NONE IDENTIFIED.

REPRODUCTIVE EFFECTS

NONE IDENTIFIED.

EFFECTS OF OVEREXPOSURE

INHALATION: IRRITATION OF UPPER RESPIRATORY TRACT
SKIN CONTACT: IRRITATION
EYE CONTACT: IRRITATION
SKIN ABSORPTION: NONE IDENTIFIED
INGESTION: NONE IDENTIFIED
CHRONIC EFFECTS: NONE IDENTIFIED

TARGET ORGANS

NONE IDENTIFIED

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

NONE IDENTIFIED

PRIMARY ROUTES OF ENTRY

INHALATION, EYE CONTACT

EMERGENCY AND FIRST AID PROCEDURES

INGESTION: IF SWALLOWED AND THE PERSON IS CONSCIOUS, IMMEDIATELY GIVE
LARGE AMOUNTS OF WATER. GET MEDICAL ATTENTION.
INHALATION: IF A PERSON BREATHES IN LARGE AMOUNTS, MOVE THE EXPOSED
PERSON TO FRESH AIR.
SKIN CONTACT: IN CASE OF CONTACT, IMMEDIATELY WASH SKIN WITH PLENTY OF
SOAP AND WATER FOR AT LEAST 15 MINUTES.
EYE CONTACT: IN CASE OF EYE CONTACT, IMMEDIATELY FLUSH WITH PLENTY OF
WATER FOR AT LEAST 15 MINUTES.

SARA/TITLE III HAZARD CATEGORIES AND LISTS

ACUTE: NO CHRONIC: YES FLAMMABILITY: NO PRESSURE: NO REACTIVITY: NO

EXTREMELY HAZARDOUS SUBSTANCE: NO
CERCLA HAZARDOUS SUBSTANCE: NO
SARA 313 TOXIC CHEMICALS: NO
TSCA INVENTORY: YES

SECTION VI - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR
CONDITIONS TO AVOID: MOISTURE, HEAT, FLAME, OTHER SOURCES OF IGNITION, AIR
INCOMPATIBLES: STRONG ACIDS, STRONG OXIDIZING AGENTS, WATER, MINERAL
ACIDS
DECOMPOSITION PRODUCTS: NONE IDENTIFIED

SECTION VII - SPILL & DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SUITABLE PROTECTIVE CLOTHING. CAREFULLY SWEEP UP AND REMOVE.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL
ENVIRONMENTAL REGULATIONS.

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

VENTILATION: USE ADEQUATE GENERAL OR LOCAL EXHAUST VENTILATION TO
KEEP FUME OR DUST LEVELS AS LOW AS POSSIBLE.
RESPIRATORY PROTECTION: NONE REQUIRED WHERE ADEQUATE VENTILATION CONDITIONS
EXIST. IF AIRBORNE CONCENTRATION IS HIGH, USE AN
APPROPRIATE RESPIRATOR OR DUST MASK.
EYE/SKIN PROTECTION: SAFETY GOGGLES, PROPER GLOVES ARE RECOMMENDED.

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA* STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

STORAGE REQUIREMENTS

KEEP CONTAINER TIGHTLY CLOSED. SUITABLE FOR ANY GENERAL CHEMICAL STORAGE
AREA. STORE IN A DRY AREA.

=====

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

=====

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME: CHEMICALS, N.O.S. (NON-REGULATED)

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME: CHEMICALS, N.O.S. (NON-REGULATED)
MARINE POLLUTANTS: NO

AIR (I.C.A.O.)

PROPER SHIPPING NAME: CHEMICALS, N.O.S. (NON-REGULATED)
U.S. CUSTOMS HARMONIZATION NUMBER: 72052900005

N/A = NOT APPLICABLE OR NOT AVAILABLE
N/E = NOT ESTABLISHED

DISCLAIMER

THE INFORMATION IN THIS MATERIAL SAFETY DATA SHEET MEETS THE REQUIREMENTS OF THE UNITED STATES OCCUPATIONAL SAFETY AND HEALTH ACT AND REGULATIONS PROMULGATED THEREUNDER (29 CFR 1910.1200 ET. SEQ.) AND THE CANADIAN WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM. THIS DOCUMENT IS INTENDED ONLY AS A GUIDE TO THE APPROPRIATE PRECAUTIONARY HANDLING OF THE MATERIAL BY A PERSON TRAINED IN, OR SUPERVISED BY A PERSON TRAINED IN, CHEMICAL HANDLING. THE USER IS RESPONSIBLE FOR DETERMINING THE PRECAUTIONS AND DANGERS OF THIS CHEMICAL FOR HIS OR HER PARTICULAR APPLICATION. DEPENDING ON USAGE, PROTECTIVE CLOTHING INCLUDING EYE AND FACE GUARDS AND RESPIRATORS MUST BE USED TO AVOID CONTACT WITH MATERIAL OR BREATHING CHEMICAL VAPORS/FUMES.

EXPOSURE TO THIS PRODUCT MAY HAVE SERIOUS ADVERSE HEALTH EFFECTS. THIS CHEMICAL MAY INTERACT WITH OTHER SUBSTANCES. SINCE THE POTENTIAL USES ARE SO VARIED, BAKER CANNOT WARN OF ALL OF THE POTENTIAL DANGERS OF USE OR INTERACTION WITH OTHER CHEMICALS OR MATERIALS. BAKER WARRANTS THAT THE CHEMICAL MEETS THE SPECIFICATIONS SET FORTH ON THE LABEL. BAKER DISCLAIMS ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED WITH REGARD TO THE PRODUCT SUPPLIED HEREUNDER, ITS MERCHANTABILITY OR ITS FITNESS FOR A PARTICULAR PURPOSE.

THE USER SHOULD RECOGNIZE THAT THIS PRODUCT CAN CAUSE SEVERE INJURY AND EVEN DEATH, ESPECIALLY IF IMPROPERLY HANDLED OR THE KNOWN DANGERS OF USE ARE NOT HEEDDED. READ ALL PRECAUTIONARY INFORMATION. AS NEW DOCUMENTED GENERAL SAFETY INFORMATION BECOMES AVAILABLE, BAKER WILL PERIODICALLY REVISE THIS MATERIAL SAFETY DATA SHEET.

NOTE: CHEMTREC, CANUTEC, AND NATIONAL RESPONSE CENTER EMERGENCY TELEPHONE NUMBERS ARE TO BE USED ONLY IN THE EVENT OF CHEMICAL EMERGENCIES INVOLVING A SPILL, LEAK, FIRE, EXPOSURE, OR ACCIDENT INVOLVING CHEMICALS. ALL NON-EMERGENCY QUESTIONS SHOULD BE DIRECTED TO CUSTOMER SERVICE (1-800-JTBAKER) FOR ASSISTANCE.

COPYRIGHT 1992 J.T.BAKER INC.
* TRADEMARKS OF J.T.BAKER INC.

====
APPROVED BY QUALITY ASSURANCE DEPARTMENT.

BAKER Accession Number 11618

Z0855 <04

ZINC

EFFECTIVE: 03/09/92

ISSUED: 12/30/92

SECTION I - PRODUCT IDENTIFICATION

PRODUCT NAME: ZINC
COMMON SYNONYMS: BLUE POWDER; CI 77945; CI PIGMENT BLACK 16
CHEMICAL FAMILY: METALS
FORMULA: ZN
FORMULA WT.: 65.37
CAS NO.: 7440-66-6
NIOSH/RTECS NO.: ZG8600000
PRODUCT USE: LABORATORY REAGENT
PRODUCT CODES: 4264, 4252, 4260, 4274, 4290, 4240, 4248, 4244, 4270, 5828

PRECAUTIONARY LABELING

BAKER SAF-T-DATA* SYSTEM

HEALTH	-	0	NONE
FLAMMABILITY	-	1	SLIGHT
REACTIVITY	-	2	MODERATE
CONTACT	-	0	NONE

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES; LAB COAT

U.S. PRECAUTIONARY LABELING

DURING USE AVOID CONTACT WITH EYES, SKIN, CLOTHING. WASH THOROUGHLY AFTER HANDLING. WHEN NOT IN USE KEEP IN TIGHTLY CLOSED CONTAINER.

INTERNATIONAL LABELING

AVOID CONTACT WITH EYES. AFTER CONTACT WITH SKIN, WASH IMMEDIATELY WITH PLENTY OF WATER. KEEP CONTAINER TIGHTLY CLOSED.

SAF-T-DATA* STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

SECTION II - COMPONENTS

COMPONENT	CAS NO.	WEIGHT %	OSHA/PEL	ACGIH/TLV
ZINC	7440-66-6	90-100	N/E	N/E

SECTION III - PHYSICAL DATA

BOILING POINT: 907 C (1664 F)
(AT 760 MM HG)

VAPOR PRESSURE (MMHG): N/A

MELTING POINT: 419 C (786 F)
(AT 760 MM HG)

SPECIFIC GRAVITY: 7.14
(H2O=1)

SOLUBILITY (H2O): NEGLIGIBLE (<0.1%)

PH: N/A

ODOR THRESHOLD (P.P.M.): N/A

COEFFICIENT WATER/OIL DISTRIBUTION: N/A

APPEARANCE & ODOR: WHITE TO BROWN METALLIC SOLID. ODORLESS.

VAPOR DENSITY (AIR=1): N/A

EVAPORATION RATE: N/A

% VOLATILES BY VOLUME: 0
(21 C)

PHYSICAL STATE: SOLID

=====

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

=====

FLASH POINT (CLOSED CUP): N/A

AUTOIGNITION TEMPERATURE: N/A

FLAMMABLE LIMITS: UPPER - N/A LOWER - N/A

FIRE EXTINGUISHING MEDIA

USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE. WARNING -
APPLICATION OF WATER TO HOT METAL MAY GENERATE STEAM.

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED
BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE
MODE.

UNUSUAL FIRE & EXPLOSION HAZARDS

DUST MAY FORM EXPLOSIVE MIXTURE WITH AIR. REACTS WITH MOST ACIDS TO
PRODUCE HYDROGEN GAS, WHICH CAN FORM AN EXPLOSIVE MIXTURE WITH AIR.

TOXIC GASES PRODUCED

ZINC FUMES, HYDROGEN

EXPLOSION DATA-SENSITIVITY TO MECHANICAL IMPACT

NONE IDENTIFIED.

EXPLOSION DATA-SENSITIVITY TO STATIC DISCHARGE

NONE IDENTIFIED.

=====

SECTION V - HEALTH HAZARD DATA

=====

THRESHOLD LIMIT VALUE (TLV/TWA): NOT ESTABLISHED

SHORT-TERM EXPOSURE LIMIT (STEL): NOT ESTABLISHED

PERMISSIBLE EXPOSURE LIMIT (PEL): NOT ESTABLISHED

TOXICITY OF COMPONENTS

NO INFORMATION IS AVAILABLE

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

CARCINOGENICITY

NONE IDENTIFIED.

REPRODUCTIVE EFFECTS

NONE IDENTIFIED.

EFFECTS OF OVEREXPOSURE

INHALATION: IRRITATION OF UPPER RESPIRATORY TRACT, HEADACHE, NAUSEA, VOMITING, DIARRHEA, CHILLS, FEVER, ACHING MUSCLES
SKIN CONTACT: PROLONGED CONTACT MAY CAUSE DERMATITIS
EYE CONTACT: NONE IDENTIFIED
SKIN ABSORPTION: NONE IDENTIFIED
INGESTION: HEADACHE, NAUSEA, VOMITING, DIZZINESS, GASTROINTESTINAL IRRITATION
CHRONIC EFFECTS: NONE IDENTIFIED

TARGET ORGANS

RESPIRATORY SYSTEM, LUNGS, PULMONARY SYSTEM, SKIN

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

RESPIRATORY SYSTEM DISEASE, GASTROINTESTINAL DISORDERS

PRIMARY ROUTES OF ENTRY

INHALATION, INGESTION, SKIN CONTACT, EYE CONTACT

EMERGENCY AND FIRST AID PROCEDURES

INGESTION: IF SWALLOWED AND THE PERSON IS CONSCIOUS, IMMEDIATELY GIVE LARGE AMOUNTS OF WATER. GET MEDICAL ATTENTION.
INHALATION: IF A PERSON BREATHE IN LARGE AMOUNTS, MOVE THE EXPOSED PERSON TO FRESH AIR.
SKIN CONTACT: IN CASE OF CONTACT, IMMEDIATELY WASH SKIN WITH PLENTY OF SOAP AND WATER FOR AT LEAST 15 MINUTES.
EYE CONTACT: IN CASE OF EYE CONTACT, IMMEDIATELY FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES.

SARA/TITLE III HAZARD CATEGORIES AND LISTS

ACUTE: YES CHRONIC: YES FLAMMABILITY: NO PRESSURE: NO REACTIVITY: NO
EXTREMELY HAZARDOUS SUBSTANCE: NO

CERCLA HAZARDOUS SUBSTANCE: YES CONTAINS ZINC (RQ = 1000 LBS)

SARA 313 TOXIC CHEMICALS: YES CONTAINS ZINC

GENERIC CLASS: GENERIC CLASS REMOVED FROM CFR: 7/1/91

TSCA INVENTORY: YES

=====

SECTION VI - REACTIVITY DATA

=====

STABILITY: STABLE	HAZARDOUS POLYMERIZATION: WILL NOT OCCUR
CONDITIONS TO AVOID:	MOISTURE, DUSTING
INCOMPATIBLES:	STRONG ACIDS, STRONG BASES, STRONG OXIDIZING AGENTS, WATER, HALOGENATED HYDROCARBONS
DECOMPOSITION PRODUCTS:	OXIDES OF ZINC, HYDROGEN

SECTION VII - SPILL & DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SUITABLE PROTECTIVE CLOTHING. CAREFULLY SWEEP UP AND REMOVE.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

=====

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

=====

VENTILATION: USE ADEQUATE GENERAL OR LOCAL EXHAUST VENTILATION TO KEEP FUME OR DUST LEVELS AS LOW AS POSSIBLE.

RESPIRATORY PROTECTION: NONE REQUIRED WHERE ADEQUATE VENTILATION CONDITIONS EXIST. IF AIRBORNE CONCENTRATION IS HIGH, USE AN APPROPRIATE RESPIRATOR OR DUST MASK.

EYE/SKIN PROTECTION: APPROPRIATE RESPIRATOR OR DUST MASK.
SAFETY GOGGLES, PROPER GLOVES ARE RECOMMENDED.

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA* STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

STORAGE REQUIREMENTS

KEEP CONTAINER TIGHTLY CLOSED. SUITABLE FOR ANY GENERAL CHEMICAL STORAGE AREA. ISOLATE FROM INCOMPATIBLE MATERIALS.

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME: CHEMICALS, N.O.S. (NON-REGULATED)

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME: CHEMICALS, N.O.S. (NON-REGULATED)
MARINE POLLUTANTS: NO

AIR (I.C.A.O.)

PROPER SHIPPING NAME: CHEMICALS, N.O.S. (NON-REGULATED)

U.S. CUSTOMS HARMONIZATION NUMBER: 79011200001

N/A = NOT APPLICABLE OR NOT AVAILABLE

N/E = NOT ESTABLISHED

Disclaimer:

THE INFORMATION IN THIS MATERIAL SAFETY DATA SHEET MEETS THE REQUIREMENTS OF THE UNITED STATES OCCUPATIONAL SAFETY AND HEALTH ACT AND REGULATIONS PROMULGATED THEREUNDER (29 CFR 1910.1200 ET. SEQ.) AND THE CANADIAN WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM. THIS DOCUMENT IS INTENDED ONLY AS A GUIDE TO THE APPROPRIATE PRECAUTIONARY HANDLING OF THE MATERIAL BY A PERSON TRAINED IN, OR SUPERVISED BY A PERSON TRAINED IN, CHEMICAL HANDLING. THE USER IS RESPONSIBLE FOR DETERMINING THE PRECAUTIONS AND DANGERS OF THIS CHEMICAL FOR HIS OR HER PARTICULAR APPLICATION. DEPENDING ON USAGE, PROTECTIVE CLOTHING INCLUDING EYE AND FACE GUARDS AND RESPIRATORS MUST BE USED TO AVOID CONTACT WITH MATERIAL OR BREATHING CHEMICAL VAPORS/FUMES.

EXPOSURE TO THIS PRODUCT MAY HAVE SERIOUS ADVERSE HEALTH EFFECTS. THIS CHEMICAL MAY INTERACT WITH OTHER SUBSTANCES. SINCE THE POTENTIAL USES ARE SO VARIED, BAKER CANNOT WARN OF ALL OF THE POTENTIAL DANGERS OF USE OR INTERACTION WITH OTHER CHEMICALS OR MATERIALS. BAKER WARRANTS THAT THE CHEMICAL MEETS THE SPECIFICATIONS SET FORTH ON THE LABEL.

BAKER DISCLAIMS ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED WITH REGARD TO THE PRODUCT SUPPLIED HEREUNDER, ITS MERCHANTABILITY OR ITS FITNESS FOR A PARTICULAR PURPOSE.

THE USER SHOULD RECOGNIZE THAT THIS PRODUCT CAN CAUSE SEVERE INJURY AND EVEN DEATH, ESPECIALLY IF IMPROPERLY HANDLED OR THE KNOWN DANGERS OF USE ARE NOT HEEDDED. READ ALL PRECAUTIONARY INFORMATION. AS NEW DOCUMENTED GENERAL SAFETY INFORMATION BECOMES AVAILABLE, BAKER WILL PERIODICALLY REVISE THIS MATERIAL SAFETY DATA SHEET.

NOTE: CHEMTREC, CANUTEC, AND NATIONAL RESPONSE CENTER EMERGENCY TELEPHONE NUMBERS ARE TO BE USED ONLY IN THE EVENT OF CHEMICAL EMERGENCIES INVOLVING A SPILL, LEAK, FIRE, EXPOSURE, OR ACCIDENT INVOLVING CHEMICALS. ALL NON-EMERGENCY QUESTIONS SHOULD BE DIRECTED TO CUSTOMER SERVICE (1-800-JTBAKER) FOR ASSISTANCE.

COPYRIGHT 1992 J.T.BAKER INC.

* TRADEMARKS OF J.T.BAKER INC.

APPROVED BY QUALITY ASSURANCE DEPARTMENT.

MALLIN Accession Number 30708

IRON REDUCED

Material Safety Data Sheet

Effective Date: 09-24-85

PRODUCT IDENTIFICATION:

Synonyms: Iron filings, iron shavings, iron powdered
Formula CAS No.: 7439-89-6 Molecular Weight: 55.85
Hazardous Ingredients: Iron reduced Chemical Formula: Fe

PRECAUTIONARY MEASURES

CAUTION! COMBUSTIBLE.
Keep away from heat and flame.

EMERGENCY FIRST AID

SEE SECTION 5.
DOT Hazard Class: ORM-C

Physical Data

Appearance:	Metal granules or shavings.	
Odor:	Odorless.	
Solubility:	Insoluble, can react with water.	
Boiling Point:	3000 C (5432 F)	Vapor Density (Air=1):No information found.
Melting Point:	1535 C (2795 F).	Vapor Pressure (mm Hg):No information found.
Specific Gravity:	7.88	Evaporation Rate:No information found.

Fire and Explosion Information

SECTION 2

Fire: Moderate fire hazard in the powdered form when exposed to heat or flame. Can react with water to liberate flammable hydrogen gas. Minimum ignition temperature of powdered iron is 240 C (464).

Explosion: Moderate explosion hazard in the form of a dust when exposed to heat or flame.

Fire Extinguishing Media: Dry chemical only. Do not use water. Do Not use carbon dioxide.

Special Information: In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

Reactivity Data

SECTION 3

Stability:

Stable under ordinary conditions of use and storage. May air-oxidize.

Hazardous Decomposition Products:

Reaction with water can produce hydrogen. Iron oxide fume may be formed in welding operations.

Hazardous Polymerization:

Will not occur.

Incompatibilities:

Strong oxidizers. Water (including humid atmospheres), halogens, acids, hydrogen peroxide, nitrogen dioxide, and polystyrene.

Leak/Spill Disposal Information

SECTION 4

Sweep, scoop or pick up spilled material. Package unreclaimable material for disposal in a RCRA-approved waste facility.

Ensure compliance with local, state and federal regulations.

Health Hazard Information

SECTION 5

A. Exposure/Health Effects

Inhalation:

Granules or shavings are not expected to have adverse effects. Excessive inhalation of dust may be irritating to the respiratory tract.

Ingestion:

Extremely large oral dosages may produce gastrointestinal disturbances.

Skin Contact:

No adverse health effects expected.

Eye Contact:

No adverse effects expected but dust may cause mechanical irritation.

Chronic Exposure:

No information found.

Aggravation of

Pre-existing Conditions:

No information found.

B. FIRST AID

Inhalation:

Remove to fresh air. Get medical attention for any breathing difficulty.

Ingestion:

Not expected to require first aid measures.

Skin Exposure:

Wash exposed area with soap and water. Get medical advice if irritation develops.

Eye Exposure:

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

C. TOXICITY

(RTECS, 1982)

No LD50/LC50 information found relating to normal routes of occupational exposure.

Occupational Control Measures

SECTION 6

Airborne Exposure Limits: None established.

Ventilation System:

In general, dilution ventilation is a satisfactory health hazard control for this substance. However, if conditions of use create discomfort to the worker, a local exhaust system should be considered.

Personal Respirators (NIOSH Approved)

For conditions of use where exposure to the dust is apparent, a dust/mist respirator may be worn. For emergencies, a self-contained breathing apparatus may be necessary.

Skin Protection:

Gloves and lab coat, apron or coveralls.

Eye Protection:

Use chemical safety goggles. Contact lenses should not be worn when working with this material.

Storage and Special Information

SECTION 7

Keep in a tightly closed container. Protect from physical damage. Store in a cool, dry, ventilated area away from sources of heat, moisture and incompatibilities.

Disclaimer:

The information contained herein is provided in good faith and is believed to be correct as of the date hereof. However, Mallinckrodt, Inc. makes no representation as to the comprehensiveness or accuracy of the information. It is expected that individuals receiving the information will exercise their independent judgment in determining its appropriateness for a particular purpose. Accordingly, Mallinckrodt, Inc. will not be responsible for damages of any kind resulting from the use of or reliance upon such information. NO REPRESENTATIONS, OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE ARE MADE HEREUNDER WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR TO THE PRODUCT TO WHICH THE INFORMATION REFERS.

Addendum to Material Safety Data Sheet

REGULATORY STATUS

Hazard Categories for SARA Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
-----	-----	-----	-----	-----

X

	SARA EHS		SARA Sec. 313		CERCLA	RCRA
Product or Components	Sec. 302		Chemicals		Sec.103	Sec.
of Product:	RQ	TPQ	Name	Chemical	RQ lbs	261.33
-----	---	---	----	-----	-----	-----
IRON REDUCED (7439-89-6)	No	No	No	No	No	No

SARA Section 302 EHS RQ:

Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.

SARA Section 302 EHS TPQ:

Threshold Planning Quantity of Extremely Hazardous substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.

SARA Section 313 Chemicals:

Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.

CERCLA Sec. 103:

Comprehensive Enviromental Response, Compensation and Liability Act (Superfund).

Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4

RCRA:

Resource Conservation and Reclamation Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261.33

ZINC METAL GRANULAR

Material Safety Data Sheet

Effective Date: 04-06-89 Supersedes 08-09-85

PRODUCT IDENTIFICATION:

Synonyms: Granular zinc; mossy zinc

Formula CAS No.: 7440-66-6

Molecular Weight: 65.37

Hazardous Ingredients: Not applicable.

Chemical Formula: Zn

PRECAUTIONARY MEASURES

As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes and clothing.

EMERGENCY FIRST AID

SEE SECTION 5.

DOT Hazard Class: Not Regulated

Physical Data

Appearance: Gray-blue granular or shiny, irregular lumps.

Odor: Odorless.

Solubility: Insoluble in water.

Boiling Point: 907 C (1665 F)

Vapor Density (Air=1): No information found.

Melting Point: 419 C (787 F)

Vapor Pressure (mm Hg): 1 @ 487 C (909 F)

Specific Gravity: 7.14

Evaporation Rate: No information found.

Fire and Explosion Information

SECTION 2

Fire: Zinc can melt under even moderate fire conditions and will burn in air. Bulk dust in damp state may heat spontaneously and ignite on exposure to air.

Explosion: Fine dust dispersed in air in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard.

Fire Extinguishing Media: Smother with a suitable dry powder (sodium chloride, magnesium oxide).

Special Information: In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

Reactivity Data

SECTION 3

Stability:

Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:

Melted zinc produces toxic zinc vapor which oxidizes and condenses in air to form zinc oxide fume.

Hazardous Polymerization:

This substance does not polymerize.

Incompatibilities:

Strong acids, alkalies and oxidizing agents, sulfur, halogens and some chlorinated materials. Hazard is greatest under conditions where the zinc is quite hot or molten.

Leak/Spill Disposal Information

SECTION 4

Sweep, scoop or pick up spilled material. Transfer to a suitable closed container, preferably metal, for intermediate storage before reclamation or disposal. Dispose in a RCRA approved facility.

Ensure compliance with local, state and federal regulations.

Health Hazard Information

SECTION 5

A. Exposure/Health Effects

Inhalation:

When heated, the fumes are highly toxic and may cause fume fever.

Ingestion:

May cause gastrointestinal disturbances.

Skin Contact:

Not expected to be a health hazard.

Eye Contact:

Small particles may cause mechanical irritation or injury to the surface of the eye. Noticeable discomfort, reddening and tearing can occur.

Chronic Exposure:

No adverse health effects expected.

Aggravation of Pre-existing Conditions:

No adverse effects expected.

B. FIRST AID

Inhalation:

Not expected to require first aid measures.

Ingestion:

If swallowed, induce vomiting immediately by giving two glasses of water and sticking finger down throat. Never give anything by mouth to an unconscious person.

Skin Exposure:

Not expected to require first aid measures.

Eye Exposure:

Wash eyes with plenty of water for at least 15 minutes. If irritation develops, get medical attention.

C. TOXICITY

(RTECS, 1982)

No LD50/LC50 information found relating to normal routes of occupational exposure.

Occupational Control Measures

SECTION 6

Airborne Exposure Limits:

-OSHA Permissible Exposure Limit (PEL): 5 mg/m3 (TWA), 10 mg/m3 (STEL) for zinc oxide fume
-ACGIH Threshold Limit Value (TLV): 5 mg/m3 (TWA), 10 mg/m3 (STEL) for zinc oxide fume

Ventilation System:

A local exhaust system which captures the contaminant at its source is recommended to prevent dispersion of the contaminant into the workroom air.

Personal Respirators
(NIOSH Approved)

For conditions of use where exposure to the dust is apparent, a dust/mist respirator may be worn. For emergencies, a self-contained breathing apparatus may be necessary.

Skin Protection:

Wear protective gloves and clean body-covering clothing.

Eye Protection:

Safety glasses. Maintain eye wash fountain and quick-drench facilities in work area.

Storage and Special Information

SECTION 7

Keep in a tightly closed container. Protect from physical damage. Store in a cool, dry, ventilated area away from sources of heat, moisture and incompatibilities.

Disclaimer:

The information contained herein is provided in good faith and is believed to be correct as of the date hereof. However, Mallinckrodt, Inc. makes no representation as to the comprehensiveness or accuracy of the information. It is expected that individuals receiving the information will exercise their independent judgment in determining its appropriateness for a particular purpose. Accordingly, Mallinckrodt, Inc. will not be responsible for damages of any kind resulting from the use of or reliance upon such information. NO REPRESENTATIONS, OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE ARE MADE HEREUNDER WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR TO THE PRODUCT TO WHICH THE INFORMATION REFERS.

Addendum to Material Safety Data Sheet
REGULATORY STATUS

This Addendum Must Not Be
Detached from the MSDS
Identifies SARA 313 substance(s)

Any copying or redistribution of the MSDS must include a copy of this addendum

Hazard Categories for SARA
Section 311/312 Reporting

Acute Chronic Fire Pressure Reactive

Product or Components of Product: -----	SARA EHS Sec. 302		SARA Sec. 313 Chemicals		CERCLA Sec.103	RCRA Sec.
	RQ	TPQ	Name List	Chemical Category	RQ lbs	261.33
-----	---	---	-----	-----	-----	-----
ZINC METAL GRANULAR (7440-66-6)	No	No	Yes	No	1000	No

SARA Section 302 EHS RQ:
Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.

SARA Section 302 EHS TPQ:
Threshold Planning Quantity of Extremely Hazardous substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.

SARA Section 313 Chemicals:
Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.

CERCLA Sec. 103:
Comprehensive Environmental Response, Compensation and Liability Act (Superfund).

Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4

RCRA:
Resource Conservation and Reclamation Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261.33

ZINC METAL POWDER

Material Safety Data Sheet

Effective Date: 04-06-89 Supersedes 08-09-85

PRODUCT IDENTIFICATION:

Synonyms: Powdered zinc; blue powder

Formula CAS No.: 7440-66-6

Hazardous Ingredients: Zinc

Molecular Weight: 65.37

Chemical Formula: Zn

PRECAUTIONARY MEASURES

WARNING! HARMFUL IF SWALLOWED OR INHALED. COMBUSTIBLE. MAY FORM
COMBUSTIBLE DUST CONCENTRATIONS IN AIR.

Avoid breathing dust.

Keep away from heat and flame.

Keep container closed.

Use with adequate ventilation.

Wash thoroughly after handling.

EMERGENCY FIRST AID

If swallowed, induce vomiting immediately by giving two glasses of water and sticking finger down throat. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases call a physician.

SEE SECTION 5.

DOT Hazard Class: Flammable Solid

Physical Data

Appearance: Gray or bluish-gray powder.

Odor: Odorless.

Solubility: Insoluble in water.

Boiling Point: 907 C (1665 F)

Vapor Density (Air=1): No information found.

Melting Point: 419 C (787 F)

Vapor Pressure (mm Hg): 1 @ 487 C (909 F)

Specific Gravity: 7.14

Evaporation Rate: No information found.

FPA Ratings: Health: 0 Flammability: 1 Reactivity: 1

Fire and Explosion Information

SECTION 2

Fire: Zinc powder is not pyrophoric but will burn in air at elevated temperatures. Autoignition temperatures are approximately 680 C (dust cloud) or 460 C (layer). Bulk dust in damp state may heat spontaneously and ignite on exposure to air. Releases flammable hydrogen gas upon contact with

acids or alkali hydroxides.

Explosion:

Fine dust dispersed in air in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard.

Fire Extinguishing Media:

Smother with a suitable dry powder (sodium chloride, magnesium oxide).

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

Reactivity Data

SECTION 3

Stability:

Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:

Hydrogen in moist air, zinc oxide with oxygen at high temperature. Zinc metal, when melted, produces zinc vapor which oxidizes and condenses in air to form zinc fume.

Hazardous Polymerization:

This substance does not polymerize.

Incompatibilities:

Zinc powder can react violently with sulfur and halogens. Dangerous or potentially dangerous with strong oxidizing agents, lower molecular weight chlorinated hydrocarbons, strong acids and alkalis.

Peak/Spill Disposal Information

SECTION 4

Remove all sources of ignition and provide mild ventilation in area of spill. Substance may be pyrophoric and self-ignite. Clean-up personnel require protective clothing, goggles and dust/mist respirators. Sweep or vacuum up the spill in a manner that does not disperse zinc powder in the air and place the zinc in a closed container for recovery or disposal. Dispose in a RCRA approved facility.

Ensure compliance with local, state and federal regulations.

Health Hazard Information

SECTION 5

Exposure/Health Effects

Inhalation:

No adverse effects expected but dust may cause mechanical irritation. The effects may be expected to resemble those of inhaling an inert dust; possible difficulty in breathing, sneezing, coughing. When heated, the fumes are highly toxic and may cause fume fever.

Ingestion: Extremely large oral dosages may produce gastrointestinal disturbances, due both to mechanical effects and the possibility of reaction with gastric juice to produce zinc chloride. Pain, stomach cramps and nausea could occur in aggravated cases.

Skin Contact: No adverse effects expected but dust may cause mechanical irritation.

Eye Contact: No adverse effects expected but dust may cause mechanical irritation.

Chronic Exposure: No adverse health effects expected.

Aggravation of Pre-existing Conditions: Persons with pre-existing skin disorders or impaired respiratory function may be more susceptible to the effects of the substance.

B. FIRST AID

Inhalation: Remove to fresh air. Get medical attention for any breathing difficulty.

Ingestion: If swallowed, induce vomiting immediately by giving two glasses of water and sticking finger down throat. Never give anything by mouth to an unconscious person.

Skin Exposure: Wash exposed area with soap and water. Get medical advice if irritation develops.

Eye Exposure: Wash eyes with plenty of water for at least 15 minutes. If irritation develops, get medical attention.

C. TOXICITY (RTECS, 1982)

No LD50/LC50 information found relating to normal routes of occupational exposure.

Occupational Control Measures SECTION 6

Airborne Exposure Limits: -OSHA Permissible Exposure Limit (PEL): 5 mg/m³ (TWA), 10 mg/m³ (STEL) for zinc oxide fume
-ACGIH Threshold Limit Value (TLV): 5 mg/m³ (TWA), 10 mg/m³ (STEL) for zinc oxide fume xide fume.

Ventilation System: A local exhaust system which captures the contaminant at its source is recommended to prevent dispersion of the contaminant into the workroom air.

Personal Respirators (NIOSH Approved) For conditions of use where exposure to the dust is apparent, a dust/mist respirator may be worn. For emergencies, a self-contained breathing apparatus may be necessary.

Skin Protection: Wear protective gloves and clean body-covering clothing.

Eye Protection: Use chemical safety goggles. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

Storage and Special Information SECTION 7

Keep in a tightly closed container. Protect from physical damage. Store in a cool, dry, ventilated area away from sources of heat, moisture and incompatibilities.

Disclaimer:

 The information contained herein is provided in good faith and is believed to be correct as of the date hereof. However, Mallinckrodt, Inc. makes no representation as to the comprehensiveness or accuracy of the information. It is expected that individuals receiving the information will exercise their independent judgment in determining its appropriateness for a particular purpose. Accordingly, Mallinckrodt, Inc. will not be responsible for damages of any kind resulting from the use of or reliance upon such information.
 NO REPRESENTATIONS, OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE ARE MADE HEREUNDER WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR TO THE PRODUCT TO WHICH THE INFORMATION REFERS.

Addendum to Material Safety Data Sheet
 REGULATORY STATUS

This Addendum Must Not Be
 Detached from the MSDS

Identifies SARA 313 substance(s)

Any copying or redistribution of the MSDS
 must include a copy of this addendum

Hazard Categories for SARA
 Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
-----	-----	-----	-----	-----
X		X		X

	SARA EHS		SARA Sec. 313		CERCLA	RCRA
	Sec. 302	TPQ	Name	Chemical	Sec.103	Sec.
Product or Components	RQ		List	Category	RQ lbs	261.33
Of Product:	---	---	----	-----	-----	-----
INC METAL POWDER (7440-66-6)	No	No	Yes	No	1000	No

SARA Section 302 EHS RQ:
 Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.

SARA Section 302 EHS TPQ:

Threshold Planning Quantity of Extremely Hazardous substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.

SARA Section 313 Chemicals:

Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.

ERCLA Sec. 103:

Comprehensive Environmental Response, Compensation and Liability Act (Superfund).

Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4

RCRA:

Resource Conservation and Reclamation Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261.33

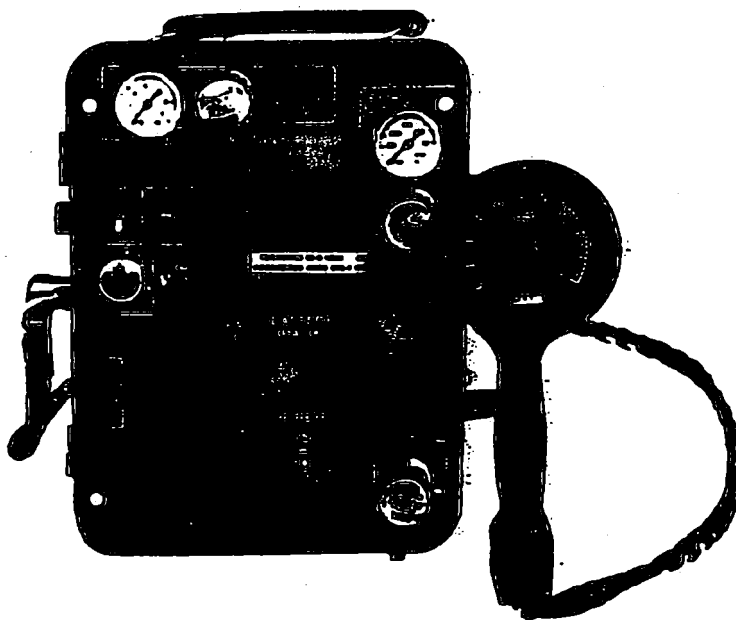
APPENDIX C

CALIBRATION, OPERATION AND ROUTINE MAINTENANCE
PROCEDURES FOR FIELD EQUIPMENT

FOXBORO COMPANY
STAMPED CT. 203-853-1616
Instruction

MI
611-132
December 1985

Model OVA 128 CENTURY Organic Vapor Analyzer



**FIGURE 1
PORTABLE ORGANIC VAPOR ANALYZER**

INTRODUCTION	1
GENERAL DESCRIPTION	2
Major Features	3
Standard Accessories	4
Particulate Filters	4
Specifications	4

OPERATING PROCEDURES	6
Controls and Indicators	6
Startup Procedure	7
Operating Procedures	7
Shut Down Procedure	8
Fuel Refilling	8
Battery Charging	8
SUMMARY OF OPERATING PROCEDURES	9
Start Up	9
Shut Down	9
CALIBRATION	10
Recalibration to Various Organic Vapors	10
Calibration Standards	10
Primary Calibration for Methane	11
SAFETY PRECAUTIONS	13
Electrical Protection	13
Fuel Supply System	13
MAINTENANCE	14
Routine Maintenance	14
Hydrogen Tank, Supply & Refill Valves	15
Air Sampling System	16
Contamination Control	16
Troubleshooting	18
Factory Maintenance	19
GAS CHROMATOGRAPH OPTION	24
Modes of Operation	24
OVA Columns	25
GC Analysis	27
GC Mode Operating Procedures	30
Survey Mode	30
Routine Maintenance	34
Troubleshooting	34
ACCESSORIES	36
Recorder	36
Charcoal Filter	39
Sample Dilutor	40
Septum Adapter	41
Portable Isothermal Pack (PIP)	41

INTRODUCTION

The Model OVA 128 CENTURY Organic Vapor Analyzer (OVA 128) is manufactured in three configurations. These are:

- Basic Flame Ionization Detector for monitoring total hydrocarbons
- Gas chromatograph supplied with two columns
- Gas chromatograph tri-column for Benzene Analysis.

A battery charger can be ordered for either 120 V ac, 60 Hz or for 220 V ac, 50 Hz. Classifications are:

- FM certified for use in Class I, Groups A, B, C, and D, Division I hazardous environments.
- BASEEFA certified intrinsically safe, Ex ib, for IIC, Zone 1, Temperature Class T6. BASEEFA No. 76002/B std. SFA 1007.

Accessories for the OVA 128 are:

- Strip Chart Recorder - either FM or BASEEFA certified.
- Activated Charcoal Filter Assembly - used for zeroing the analyzer in a contaminated environment. Also used with desiccant as a moisture trap.
- * - Sample Dilutor Assembly for 10:1, 25:1, or 50:1 sample dilution.
- Septum Adapter for direct, on-line injection with the GC.
- Portable Isothermal Pack (PIP) for temperature control of GC columns.

The OVA 128 is a sensitive instrument designed to measure trace quantities of organic materials in air. It is essentially a flame ionization detector such as utilized in laboratory gas chromatographs and has similar analytical capabilities. The flame ionization detector is an almost universal detector for organic compounds with the sensitivity to measure in the parts per million range (V/V) in the presence of atmospheric moisture, nitrogen oxides, carbon monoxide, and carbon dioxide.

The instrument has broad application since it has a chemically resistant air sampling system and can be readily calibrated to measure almost all organic vapors. It has a single linearly scaled readout from 0 ppm to 10 ppm with a X1, X10, and X100 range switch. This range expansion feature provides accurate readings across a wide concentration range with either 10, 100 or 1000 ppm full scale deflection. Designed for use as a portable survey instrument, it can also be readily adapted to fixed remote monitoring or mobile installations. It is ideal for the determination of many organic air pollutants and for monitoring the air in potentially contaminated areas.

The OVA 128 is certified by Factory Mutual Research Corporation (FM) for use in Class I, Groups A, B, C, & D, Division I hazardous locations. Similar foreign certifications have been obtained, including BASEEFA. This requirement is especially significant in industries where volatile flammable petroleum or chemical products are manufactured or used and for instruments which are used in portable surveying or for analyzing concentrations of gases and vapors. Such instruments must be incapable, under normal or abnormal conditions, of causing ignition of hazardous mixtures in the air. In order to maintain the certified safety, it is important that the precautions outlined in this manual be practiced and that no modifications be made to these instruments.

It is highly recommended that the entire manual be read before operating the instrument. It is essential that all portions relating to safety of operation and maintenance be thoroughly understood.

Reference Literature

- MI 611-101 Operation of Tri-Column GC Option
- MI 611-102 Operation of Dilutor Kit
- MI 611-103 Operation of Portable Isothermal Pack

GENERAL DESCRIPTION

The OVA 128 Analyzer is designed to detect and measure hazardous organic vapors and gases found in most industries. It has broad application since it has a chemically resistant sampling system and can be calibrated to almost all organic vapors. It can provide accurate indication of gas concentration in one of three ranges: 0 to 10 ppm; 0 to 100 ppm; or 0 to 1000 ppm. While designed as a lightweight portable instrument, it can be permanently installed to monitor a fixed point.

The instrument utilizes the principle of hydrogen flame ionization for detection and measurement of organic vapors. The instrument measures organic vapor concentration by producing a response to an unknown sample, which can be related to a gas of known composition to which the instrument has previously been calibrated. During normal survey mode operation, a continuous sample is drawn into the probe and transmitted to the detector chamber by an internal pumping system.

The sample stream is metered and passed through particle filters before reaching the detector chamber. Inside the detector chamber, the sample is exposed to a hydrogen flame which ionizes the organic vapors. When most organic vapors burn, they leave positively charged carbon-containing ions. An electric field drives the ions to a collecting electrode. As the positive ions are collected, a current corresponding to the collection rate is generated. This current is measured with a linear electrometer preamplifier which has an output signal proportional to the ionization current. A signal conditioning amplifier is used to amplify the signal from the preamp and to condition it for subsequent meter or external recorder display. The display is an integral part of the Probe/Readout Assembly and has 270° scale deflection.

In general, the hydrogen flame ionization detector is more sensitive for hydrocarbons than any other class of organic compounds. The response of the OVA varies from compound to compound, but gives repeatable results with all types of hydrocarbons; i.e., saturated hydrocarbons (alkanes), unsaturated hydrocarbons (alkenes and alkynes) and aromatic hydrocarbons.

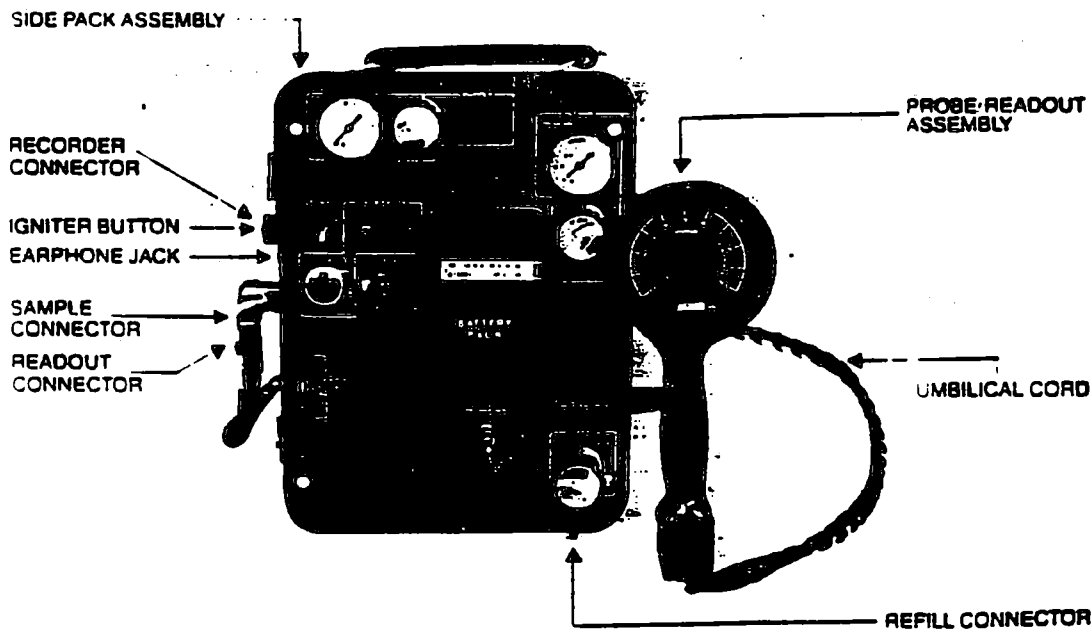


FIGURE 2
PORTABLE ORGANIC VAPOR ANALYZER
Model OVA 128

Typical response of various hydrocarbons, relative to methane is as follows:

Compound	Relative Response (percent)
Methane	100 (reference)
Hexane	70
Propane	64
N-butane	61
N-pentane	100
Ethylene	85
Acetylene	200
Benzene	150
Toluene	120
Ethane	90

Compounds containing oxygen, such as alcohols, ethers, aldehydes, carboxylic acid and esters give a lower response than that observed for hydrocarbons. This is particularly noticeable with compounds having a high ratio of oxygen to carbon such as the lower members of each series which have one, two or three carbons. With compounds containing higher numbers of carbons, the effect is diminished to such an extent that the response is similar to that of the corresponding hydrocarbons.

Nitrogen-containing compounds (i.e., amines, amides, and nitriles) respond in a manner similar to that observed for oxygenated materials. Halogenated compounds also show a lower relative response as compared with hydrocarbons. Materials containing no hydrogen, such as carbon tetrachloride, give the lowest response; the presence of hydrogen in the compounds results in higher relative responses. Thus, CHCl_3 gives a much higher response than does CCl_4 . As in the other cases, when the carbon to halogen ratio is 3:1 or greater, the response will be similar to that observed for simple hydrocarbons.

***NOTE:** Each OVA detector will have slightly different responses for organic vapors relative to methane. The user should determine responses for his individual instrument. The typical response of various compounds relative to methane is as follows:

KETONES	
Acetone	60
Methyl ethyl ketone	80
Methyl isobutyl ketone	100
ALCOHOLS	
Methyl alcohol	15
Ethyl	25
Isopropyl	65
HALOGEN COMPOUNDS	
Carbon tetrachloride	10
Chloroform	65
Trichloroethylene	70
Vinyl chloride	35

The OVA has negligible response to carbon monoxide and carbon dioxide which, due to their structure, do not produce appreciable ions in the detector flame. Thus, other organic materials may be analyzed in the presence of CO and CO_2 .

Applications

- (1) Measurement of most toxic organic vapors present in industry for compliance with Occupational Safety and Health Administration (OSHA) requirements.
- (2) Evaluation and monitoring applications in the air pollution field.
- (3) Source identification and measurement for fugitive emissions (leaks) as defined by EPA.
- (4) Forensic science applications.
- (5) Controlling and monitoring atmospheres in manufacturing and packaging operations.
- (6) Leak detection related to volatile fuel handling equipment.
- (7) Monitoring the background level of organic vapors at hazardous waste sites.
- (8) Quality control procedures geared to leak checking, pressurized system checks, combustion efficiency checks, etc.

Major Features

The basic instrument consists of two major assemblies, the Probe/Readout Assembly and the Side Pack Assembly (See Figure 2). The recorder is optional on all models, but is normally used with all instruments which incorporate the GC Option. The output meter and alarm level adjustments are incorporated in the Probe/Readout Assembly.

The Side Pack Assembly contains the remaining operating controls and indicators, electronic circuitry, detector chamber, hydrogen fuel supply, and electrical power supply.

Other major features are: linear scale readout, approximately two second response time and portable operating time of 8 hours for fuel supply and battery pack. A battery test feature allows charge condition to be read on the meter. Hydrogen flame-out is signified by an audible alarm plus a visual indication on the meter. The instrument contains a frequency modulated detection alarm which can be preset to sound at a desired concentration level. The frequency of the detection alarm varies as a function of detected level giving an audible indication of organic vapor concentration. An earphone is provided to allow the operator to hear the alarm in noisy areas or to avoid disturbing workers.

During use, the Side Pack Assembly can be carried by the operator on either his left or right side or as a back pack. The Probe/Readout Assembly can be detached from the Side Pack Assembly and disassembled for transport and storage.

Standard Accessories

A variety of sampling fixtures can be used. In addition, small diameter tubing can be used for remote sampling or electrically insulated flexible extensions can be used for places that are difficult to reach.

Telescoping Probe

Probe length can be increased or decreased over a 22 to 30 inch range to suit the individual user. A knurled locking nut is used to lock the probe at the desired length. The probe is attached to the Readout Assembly. When appropriate, the probe is replaced with a Close Area Sampler, which is supplied as a standard accessory.

Sampling Accessories

Part Number	Description
510125-1	Close area sampler - Connects directly to the readout assembly.
510035-1	Telescoping wand - Adjustable length - accommodates the probe listed below.
510126-1	Tubular area sampler - Used with the telescoping wand.

Particulate Filters

The primary filter of porous stainless steel is located behind the sample inlet connector (see Side Pack Assembly drawing). In addition, a replaceable porous metal filter is installed in the "close area" sampler.

Carrying Case

An instrument carrying case is provided to transport, ship and store the disassembled Probe/Readout Assembly, the Side Pack Assembly and other equipment.

Specifications

READOUT: 0 to 10, 0 to 100, 0 to 1000 ppm (linear)
SAMPLE FLOW RATE: 1 1/2 to 2 1/2 litre per minute at 22°C, 760 mm, using close area sampler
RESPONSE TIME: Approximately 2 seconds for 90% of final reading.
PRIMARY ELECTRICAL POWER: 12 volt (nominal) battery pack.
FUEL SUPPLY: Approximately 75 mL volume tank of pure hydrogen, maximum pressure 2400 psig, fillable in case.
HYDROGEN FLOW RATE: Factory set 12.5 \pm 0.5 mL/min (minus GC option) 11.0 \pm 0.5 mL/min (GC models)
PORTABLE OPERATING TIME: Minimum 8 hours with battery fully charged, hydrogen pressure at 1800 psig.
PHYSICAL DIMENSIONS: 9" x 12" x 5" (229 mm x 305 mm x 127 mm) Sidepack only.
WEIGHT: 12 pounds (5.5 kg) (sidepack and hand-held probe assembly)
DETECTION ALARM: Audible alarm plus meter indication. User preset to desired level.
FLAME-OUT ALARM: Audible alarm plus meter indication (needle drops off scale in negative direction).
BATTERY TEST: Battery charge condition indicated on readout meter. Upon activation of momentary contact switch, a meter reading above the indicator line means that there is 4 hours minimum service life remaining (at 22°C).
FILTERS: In-line sintered metal filters will remove particles larger than 10 microns.
OPERATING TEMPERATURE RANGE: 10°C to 40°C.
MINIMUM AMBIENT TEMPERATURE: 15°C for flame ignition (coldstart).
ACCURACY: Based on the use of a calibration gas for each range.

Calibration Temp. °C	Operating Temp. °C	Accuracy in % of Individual Full Scale		
		X1	X2	X3
20 to 25	20 to 25	+20	-10	-10
20 to 25	10 to 40	-20	-10	-10

RELATIVE HUMIDITY: 5% to 95%. Effect
on accuracy: $\pm 20\%$ of individual
full scale

RECORDER OUTPUT: 0 to 5 volts

MINIMUM DETECTABLE LIMIT (METHANE):
0.2 ppm

STANDARD ACCESSORIES:

1. Instrument carrying and storage case
2. Hydrogen fuel filling hose assembly
3. Battery charger
4. Earphone
5. Various sampling fixtures
6. Maintenance tool kit
7. Operators manual (2 each)
8. Padded leather carrying straps

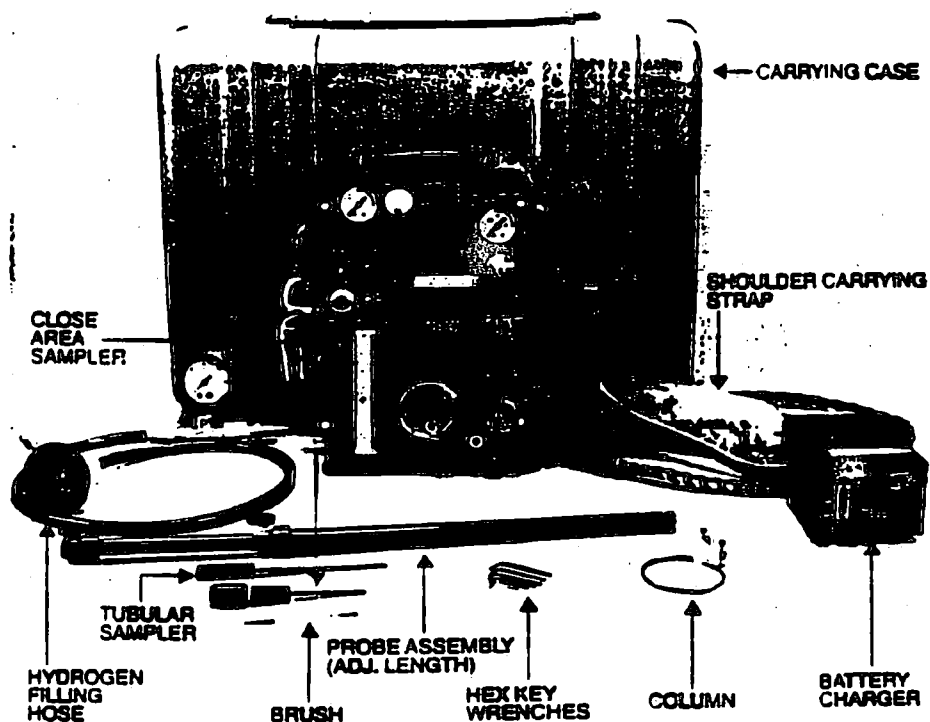


FIGURE 3
OVA-128 ANALYZER COMPONENTS
(Gas Chromatograph Model Shown)

OPERATING PROCEDURES

Controls and Indicators

Sidepack Assembly

- 1) INSTR/BATT Test Switch* - Three position toggle switch controls all instrument electrical power except the pump and alarm power. It also permits display of the battery charge condition on the readout meter.
- 2) PUMP (ON/OFF) Switch* - Toggle switch controls power to the internal pump and audio alarms.
- 3) Igniter Switch - Momentary push button switch connects power to the igniter coil in the detector chamber and simultaneously disconnects power to pump.
- 4) CALIBRATE Switch (range selector) - Selects the desired range: (1) 0 to 10 ppm; (10 to 100 ppm); (100 to 1000 ppm).
- 5) CALIBRATE ADJUST (zero) Knob - Potentiometer used to "zero" the instrument.
- 6) GAS SELECT KNOB (span control) - Ten-turn dial readout potentiometer sets the gain of the instrument (commonly referred to as span control).
- 7) Recorder Connector - Five-pin connector used to connect the instrument to an external recorder with the following pin connections:
 Pin E - + 12 V dc
 Pin H - Ground
 Pin B - Signal 0 to 5 V dc
- 8) Charger Connector - BNC connector used to connect the battery pack to the battery charger.
- 9) HYDROGEN TANK VALVE - Valve used to supply or close off the fuel supply from the hydrogen tank.
- 10) HYDROGEN TANK PRESSURE Indicator - High pressure gauge measures pressure in the hydrogen fuel tank which is an indication of fuel supply.
- 11) HYDROGEN SUPPLY VALVE - Valve used to supply or close off hydrogen fuel to the detector chamber.

- 12) HYDROGEN SUPPLY PRESSURE Indicator - Low pressure gauge used to monitor hydrogen pressure at the capillary restrictor.
- 13) SAMPLE FLOW RATE Indicator - Indicator to monitor the sample flow rate.
- 14) REFILL CONNECTION - 1 in AN fitting to connect the hydrogen refill hose to the instrument.
- 15) REFILL VALVE - Valve to open one end of the instrument fuel tank for refilling with hydrogen.
- 16) EARPHONE JACK - Used to connect the earphone; speaker is disabled when earphone is used.
- 17) VOLUME Knob - Potentiometer adjusts the volume of the internal speaker and earphone.
- 18) Readout and Sample Connectors - Used to connect the sample nose and umbilical cord from the Probe/Readout to the Side Pack.

Controls and Indicators

Probe/Readout Assembly

- 1) Meter - Linear scaled 270° meter displays the output signal level in ppm.
- 2) Alarm Level Adjust Knob - Potentiometer (located on the back of the Readout Assembly) is used to set the concentration level at which the audible alarm is actuated.

*Special Switch - switch handle must be pulled to change position. This prevents accidental movement.

Startup Procedure

- a) Connect the Probe/Readout Assembly to the Sidepack Assembly by attaching the sample line and electronic jack to the Sidepack.
- b) Select the desired sample probe (close area sampler or telescoping probe) and connect the probe handle. Before tightening the knurled nut, check that the probe accessory is firmly seated against the flat seals in the probe handle and in the tip of the telescoping probe.
- c) Move the Instr/Batt Switch to the test position. The meter needle should move to a point beyond the white line, indicating that the integral battery has more than 4 hours of operating life before recharging is necessary.
- d) Move the Instr/Batt Switch to the "ON" position and allow a 5 minute warm-up.
- e) Turn the Pump Switch on.
- f) Use the Calibrate Adjust knob to set the meter needle to the level desired for activating the audible alarm. If this alarm level is other than zero, the Calibrate Switch must be set to the appropriate range.
- g) Turn the Volume Knob fully clockwise.
- h) Using the Alarm Level Adjust knob, turn the knob until the audible alarm is activated.
- i) Move the Calibrate Switch to X1 and adjust the meter reading to zero using the Calibrate Adjust (zero knob).
- j) Open the hydrogen Tank Valve 1 or 2 turns and observe the reading on the Hydrogen Tank Pressure Indicator. (Approximately 150 psi of pressure is required for each hour of operation).
- k) Open the Hydrogen Supply Valve 1 or 2 turns and observe the reading on the Hydrogen Supply Pressure Indicator. The reading should be between 8 and 12 psi.

Note: With GC instrument, a column or jumper must be installed.

- l) After approximately one minute, depress the Igniter Button until the hydrogen flame lights. The meter needle will travel upscale and begin to read "Total Organic Vapors". Caution: Do not depress igniter for more than 6 seconds. If flame does not ignite, wait one minute and try again.
- m) The instrument is ready for use.
NOTE: If the ambient background organic vapors are "zeroed out" using the Calibrate Adjust knob, the meter needle may move off-scale in the negative direction when the OVA is moved to a location with lower background. If the OVA is to be used in the 0 to 10 ppm range, it should be "zeroed" in an area with very low background. A charcoal filter (Part No. 510095-1) can be used to generate the clean background sample.

Operating Procedures

The following procedure describes operation of the OVA in the "Survey Mode" to detect total organic vapors.

- a) Set the CALIBRATE Switch to the desired range. Survey the areas of interest while observing the meter and/or listening for the audible alarm indication. For ease of operation, carry the Side Pack Assembly positioned on the side opposite the hand which holds the Probe/Readout Assembly. For broad surveys outdoors, the pickup fixture should be positioned several feet above ground level. When making quantitative readings or pinpointing, the pickup fixture should be positioned at the point of interest.
- b) When organic vapors are detected, the meter pointer will move upscale and the audible alarm will sound when the setpoint is exceeded. The frequency of the alarm will increase as the detection level increases.

If the flame-out alarm is actuated, check that the pump is running, then press the igniter button. Under normal conditions, flame-out results from sampling a gas mixture that is above the lower explosive level which causes the hydrogen flame to extinguish. If this is the case, reignition is all that is required to resume monitoring. Another possible cause for flame-out is restriction of the sample flow line which would not allow sufficient air into the chamber to support combustion. The normal cause for such restriction is a clogged particle filter.

It should be noted that the chamber exhaust port is on the bottom of the case and blocking this port with the hand will cause fluctuations and/or flame out.

Shut Down Procedure

The following procedure should be followed for shut down of the equipment:

- A. Close HYDROGEN TANK VALVE
- B. Close HYDROGEN SUPPLY VALVE
- C. Move INSTR Switch to OFF
- D. Wait 5 seconds and move PUMP Switch to OFF. INSTRUMENT IS NOW IN A SHUT DOWN CONFIGURATION.

Fuel Refilling

NOTE: ~~Use PREPURIFIED or ZERO grade hydrogen gas. Do not use commercial grade hydrogen gas. Methane <0.5 ppm recommended.~~

- a) The instrument and the charger should be completely shut down during hydrogen tank refilling operations. Refilling should be done in a ventilated area. THERE SHOULD BE NO POTENTIAL IGNITERS OR FLAME IN THE AREA.
- b) If you are making the first filling on the instrument or if the filling hose has been allowed to fill with air, the filling hose should be purged with hydrogen prior to filling the instrument tank. This purging is not required for subsequent fillings.
- c) The filling hose assembly should be left attached to the hydrogen supply tank when possible. Ensure that the FILL/BLEED Valve on the instrument end of the hose is in the OFF position. Connect the hose to the refill connection on the Side Pack Assembly.

- d) Open the hydrogen supply bottle valve slightly. Open the REFILL VALVE and the HYDROGEN TANK VALVE on the instrument panel and place the FILL/BLEED Valve on the filling hose assembly in the FILL position. The pressure in the instrument tank will be indicated on the HYDROGEN TANK PRESSURE Indicator.
- e) After the instrument fuel tank is filled, close the REFILL VALVE on the panel, the FILL/BLEED Valve on the filling hose assembly and the hydrogen supply bottle valve.
- f) The hydrogen trapped in the nose should now be bled off to atmospheric pressure. CAUTION should be used in this operation as described in Step (g) below, since the hose will contain a significant amount of hydrogen at high pressure.
- g) The nose is bled by turning the FILL/BLEED Valve on the filling hose assembly to the BLEED position. After the nose is bled down to atmospheric pressure, the FILL/BLEED Valve should be turned to the FILL position to allow the hydrogen trapped in the connection fittings to go into the hose assembly. Then, again, turn the FILL/BLEED Valve to the BLEED position and exhaust the trapped hydrogen. Then turn the FILL/BLEED Valve to OFF to keep the hydrogen at one atmosphere in the hose so that at the time of the next filling there will be no air trapped in the filling line.
- h) Close the HYDROGEN TANK VALVE.
- i) With the HYDROGEN TANK VALVE and the HYDROGEN SUPPLY VALVE closed, a small amount of HYDROGEN at high pressure will be present in the regulators and plumbing. As a leak check, observe the HYDROGEN TANK PRESSURE Indicator while the remainder of the system is shut down and ensure that the pressure reading does not decrease rapidly (more than 350 psi/h) which would indicate a significant leak in the supply system.

Battery Charging

WARNING: Never charge in a hazardous environment.

- a) Plug charger connector into mating connector on battery cover and insert ac plug into 115 V ac wall outlet.
- b) Move the battery charger switch to the ON position. The lamp above the switch button should illuminate.
- c) Battery charge condition is indicated by the meter on the front panel of the charger; meter will deflect to the left when charging. When fully charged, the pointer will be in line with "charged" marker above the scale.
- d) Approximately one hour of charging time is required for each hour of operation. However, an overnight charge is recommended. The charger can be left on indefinitely without damaging the batteries. When finished, move the battery charger switch to OFF and disconnect from the Side Pack Assembly.

THE FOLLOWING ARE SPECIAL INSTRUCTIONS FOR RECHARGING BATTERIES WHICH HAVE BEEN COMPLETELY DISCHARGED.

It has been established that the above battery charging procedures may not be effective when the operator has allowed the battery to COMPLETELY discharge.

When this happens and the above procedures fail to charge the battery, perform the following additional steps:

- e) Remove the battery from the instrument case.
- f) Connect to any variable dc power supply.
- g) Apply 40 volts at 4 ampere maximum.
- h) Observe the power supply meter. As soon as the battery begins to draw current, gradually reduce the power maintaining 4 A maximum until the meter reads approximately 15 volts.

NOTE: The time required to reach the 15 volt reading will depend on degree of discharge.

- i) Repeat steps (a), (b), (c), and (d) above to complete the charging cycle.

SUMMARY OF OPERATING PROCEDURES

Start Up

- a) Check battery condition by moving the INSTR Switch to the BATT position.
- b) Move INSTR Switch to ON and allow five (5) minutes to warm-up.
- c) Use the Calibrate Adjust knob to set the meter needle to the level desired for activating the audible alarm. If this alarm level is other than zero, the Calibrate Switch must be set to the appropriate range.
- d) Turn the Volume Knob fully clockwise.
- e) Using the Alarm Level Adjust knob, turn the knob until the audible alarm is activated.
- f) Set CALIBRATE Switch to X1 position, use CALIBRATE Knob and set meter to read 0.
- g) Move PUMP Switch to ON position, then place instrument panel in vertical position and check SAMPLE FLOW RATE indication. The normal range is 1.5 to 2.5 units. If less, check filters.
- h) Open the HYDROGEN TANK VALVE and the HYDROGEN SUPPLY VALVE. Wait one minute for hydrogen to purge the system.
- i) Depress Igniter Button until burner lights. Do not depress Igniter Button for more than six seconds. (If burner does not ignite, let hydrogen flow for one minute and again attempt ignition.)
- j) Use CALIBRATE Knob to "zero" out ambient background. For maximum sensitivity below 10 ppm, set CALIBRATE Switch to X1 and readjust zero on meter. To avoid false flame-out alarm indication, set meter to 1 ppm with CALIBRATE Knob and make differential readings from there.

Shut Down

- a) Close the HYDROGEN SUPPLY VALVE
- b) Close the HYDROGEN TANK VALVE
- c) Move the INSTR Switch and PUMP Switch to OFF
- d) Instrument is now in shut down configuration

CALIBRATION

Recalibration to Various Organic Vapors

The OVA 128 is capable of responding to nearly all organic compounds. At the time of manufacture, the analyzer is calibrated to mixtures of methane in air. For precise analysis it is necessary to recalibrate with the specific compound of interest. The GAS SELECT control is used to set the electronic gain for a particular compound.

The instrument is recalibrated using a mixture of a specific vapor in air, with known concentration. After the instrument is in operation and the normal background is zeroed, draw a sample of the calibration gas into the instrument. The GAS SELECT Knob on the panel is then used to set the read-out meter indication to correspond to the concentration of the calibration gas mixture.

The instrument has now been calibrated to the vapor mixture being used. After this adjustment, the setting on the "dial" should be recorded for that particular organic vapor compound. This exercise can be performed for a large variety of compounds, thereby generating a "library" which can be used for future reference without need for additional calibration standards.

To read a particular compound, the GAS SELECT control is turned to the predetermined setting for the compound. Calibration on any one range automatically calibrates the other two ranges.

Using Empirical Data

Relative response data can be used to estimate the concentration of a vapor without need to recalibrate the analyzer. With the instrument calibrated to methane, obtain the concentration reading for a calibration sample of the test vapor. The response factor (R) in percent, for that vapor is:

$$R = \frac{\text{Actual Concentration}}{\text{Measured Concentration}}$$

To determine the concentration of an unknown sample of that vapor, multiply the measured concentration by R.

Calibration Standards

Commercial Standards

Commercially available standard samples offer the most convenience and are recommended for the most precise analyses. Always remember to obtain the desired vapor in an air background. Samples should be drawn from the cylinder into a collapsed sample bag, then drawn from the bag by the instrument to prevent a pressure or vacuum at the sample inlet.

Preparation of Standards

The following procedure is for generating calibration standards as an alternative to using commercial mixtures.

Obtain a five (5) gallon glass bottle and determine its volume by measuring the volume of water needed to fill it (use of a 1000 mL graduated cylinder is convenient). Another approach is to weigh the empty bottle, fill it with water and weigh again. The difference between the two values is the weight of water. By multiplying the weight of water in pounds by 0.455, obtain the volume of the bottle in liters. Empty the water and allow the bottle to dry. Place a one-foot piece of Teflon tubing in the flask to aid in mixing the vapors uniformly with the air. The volume of such a bottle should be about 20 liters, which is 20,000 mL. If the volume were 20,000 mL, then a 2 mL sample of a gas would be equivalent to 200 mL per 2 million mL or 100 ppm (V/V). Use of a gas tight Syringe, readable in 0.01 mL, allows the preparation of mixtures in the 1-2 ppm range, which are sufficient for the quantitative estimation of concentrations. A plastic stopper is loosely fitted to the tip of the bottle. The needle of the syringe is placed inside the jug neck and the stopper squeezed against the needle to decrease leakage during sample introduction. Inject the sample into the bottle and withdraw the needle without removing the stopper. Tighten the stopper and shake the bottle for a few minutes with sufficient vigor that the plastic tubing in the bottle moves around to ensure good mixture of the vapors with the air.

Calculations

$$\text{Injection} = \frac{\text{Volume Concentration} \times \text{Molecular Weight} \times \text{System Volume}}{\text{Density} \times \text{Molar Volume at STP}}$$

$$= \frac{(C) (MW) (V)}{(D) (V)}$$

Using the Ideal Gas Law, $PV=RT$, the molar volume of any gas at STP (25°C and 1 atm) is:

$$V = \frac{RT}{P} = \frac{\text{Universal Gas Constant} \times \text{Temperature}}{\text{Pressure}}$$

$$= \frac{(0.08206 \frac{\text{litre atm}}{\text{mol K}}) (298.15 \text{ K})}{1 \text{ atm}}$$

$$= (24.47 \text{ L}) (\text{mol}^{-1})$$

Therefore, the injection volume necessary to prepare 1 liter of a 100 ppm sample of hexane would be:

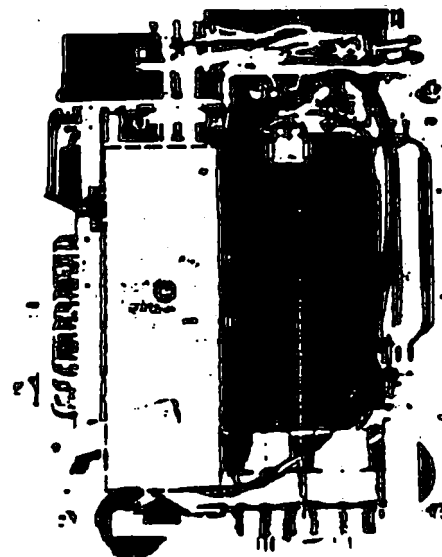
$$\begin{aligned} \text{Injection Volume} &= \frac{(100 \text{ ppm}) (86.18 \text{ g}) (\text{mol}^{-1}) (1 \text{ liter})}{(0.659 \text{ g}) (\text{mL}^{-1}) [(24.47 \text{ L}) (\text{mol}^{-1})] [(1000 \text{ mL}) (\text{L}^{-1})]} \\ &= 0.534 \mu\text{L} \end{aligned}$$

• STP - Standard Temperature and Pressure

Primary Calibration for Methane

Internal electronic adjustments are provided to calibrate and align the circuits. After initial factory calibration, it should not be necessary to repeat the calibration unless the analyzer undergoes repairs which affect calibration. If the OVA 128 will be extensively used for analysis of a sample other than methane, recalibration of the electronics (after resetting the GAS SELECT CONTROL) may result in better accuracy. See Recalibration to Various Organic Vapors above.

Primary calibration of this instrument is accomplished at the factory using methane-in-air, sample gases.



R-31 R-32 R-33 R-38

FIGURE 4
LOCATION OF ELECTRONIC ADJUSTMENTS

Calibration Using Known Samples for Each Range (Refer to Figure 4)

The accuracy stated under Specifications is obtained when the instrument is calibrated with known concentrations for each range. Prepare separate samples of methane-in-air in these concentration ranges: 7 to 10 ppm, 90 to 100 ppm, and 900 to 1000 ppm. Calibrate the instrument as follows:

- a) Place the instrument in normal operation and allow a minimum of 15 minutes for warm-up and stabilization.
- b) Set the GAS SELECT control to 100.
- c) Set the CALIBRATE Switch to X1.
- d) Set the CALIBRATE ADJUST (Zero) Knob so that the meter reads zero.
- e) Check that the meter reads zero on the X10 and X100 ranges.
- f) Set the CALIBRATE Switch to X1 and introduce the sample with known concentration in the 7 to 10 ppm range.
- g) Adjust R31 so that the meter reading corresponds to the sample concentration.
- h) Set the CALIBRATE Switch to X10 and introduce the sample with known concentration in the 90 to 100 ppm range.
- i) Adjust R32 so that the meter reading corresponds to the sample concentration.
- j) Set the CALIBRATE Switch to X100 and introduce the sample with known concentration in the 900 to 1000 ppm range.
- k) Adjust R33 so that the meter reading corresponds to the sample concentration.
- l) The instrument is now calibrated for methane and ready for service.

Calibration Using a Single Sample Calibration (Refer to Figure 4)

Calibration may be accomplished using a single known sample of methane in air in the range of 90 to 100 ppm. This may not provide the accuracy stated under specifications but is adequate for field survey work.

- a) Place instrument in normal operation with CALIBRATE Switch set to X10 and GAS SELECT control set to 100.
- b) Use the CALIBRATE ADJUST (zero) Knob to adjust the meter reading to zero.
- c) Introduce a methane sample of a known concentration (between 90 and 100 ppm not to exceed 100 ppm) and adjust trimpot R-32 so the meter reading corresponds to the known sample.
- d) This sets the instrument gain for methane with the panel mounted gain adjustment (GAS SELECT) set at a reference number of 100.
- e) Turn off HYDROGEN SUPPLY VALVE to put out flame.
- f) Leave CALIBRATE Switch on X10 position and use CALIBRATE ADJUST (zero) Knob to adjust meter reading to 4 ppm.
- g) Place CALIBRATE Switch in X1 position and using trimpot R-31 adjust meter reading to 4 ppm.
- h) Move CALIBRATE Switch to X10 position again. Use CALIBRATE ADJUST (zero) Knob to adjust meter to a reading of 40 ppm.
- i) Move CALIBRATE Switch to X100 position and use trimpot R-33 to adjust meter reading to 40 ppm.
- j) Move CALIBRATE ADJUST (zero) Knob to adjust meter reading to zero.
- k) Unit is now balanced from range to range, calibrated to methane, and ready to be placed in normal service.

SAFETY PRECAUTIONS

The OVA 128 has been tested and certified by Factory Mutual Research Corporation (FM) as safe for use in Class I, Division 1, Groups A, B, C and D hazardous atmospheres. Similar foreign certifications have been obtained, including BASEEFA. Special restrictions must be strictly adhered to, to ensure the certification is not invalidated by actions of operating or service personnel.

All flame ionization hydrocarbon detectors are potentially hazardous since they use hydrogen or hydrogen mixtures in the detector cell. Mixtures of hydrogen and air are flammable over a wide range of concentrations whether an inert gas such as nitrogen is present or not. Therefore, the recommended precautions and procedures should be followed for maximum safety. Safety considerations were a major factor in the design of the Organic Vapor Analyzer (OVA).

All connections are of the permanent type as opposed to quick disconnect. To protect against external ignition of flammable gas mixtures, the flame detection chamber has porous metal flame arrestors on the sample input and the exhaust ports as well as on the hydrogen inlet connector. The standard battery pack and other circuits are internally current limited to an intrinsically safe level.

No Modifications Permissible

It is imperative that operation and service procedures described in this manual be carefully followed in order to maintain the intrinsic safety which is built into the OVA. NO MODIFICATION TO THIS INSTRUMENT IS PERMISSIBLE. Therefore, component replacement must be accomplished with approved parts.

Electrical Protection

The 12 V battery power supply circuit is current limited to an intrinsically safe level. Fuses are not utilized and all current limiting resistors and other components which are critical to the safety certification are encapsulated to prevent inadvertent replacement with components of the wrong value or specification. Under no circumstances should the encapsulation be removed.

Fuel Supply System

The OVA fuel tank has a volume of approximately 75 cm³ which, when filled to the maximum rated pressure of 2300 psig, holds approximately 5/8 ft³ of gas. The fuel used in the OVA should be PREPURIIFIED or ZERO grade hydrogen (certified total hydrocarbons as methane < 5 ppm recommended.)

Hydrogen gas gains heat when expanding and, therefore, should not be rapidly released from a high pressure tank to a low pressure environment. Flow restrictors are incorporated in the hydrogen refill fitting and hydrogen is restricted on the output side of the tank by the low flow rate control system. In addition, a special flow restrictor is incorporated in the FILL/BLEED valve of the hydrogen filling nose assembly. These precautions limit the flow rate of the hydrogen to prevent ignition due to self-heat from expansion.

Precautions should be taken during hydrogen filling or hydrogen emptying operations to ensure that there are no sources of ignition in the immediate area. Since the instrument tank at 2300 psig holds only 5/8 ft³ of hydrogen, the total quantity, if released to the atmosphere, would be quickly diluted to a non-flammable level. There is, however, the possibility of generating flammable mixtures in the immediate vicinity of the instrument during filling or emptying operations if normal care is not exercised.

Detector Chamber

The input and output ports of the flame ionization chamber have sintered metal flame arrestors. The chamber is ruggedly constructed of Teflon such that even if highly explosive mixtures of hydrogen and air are inadvertently created in the chamber and ignited, the chamber would NOT rupture.

MAINTENANCE

This section describes the routine maintenance schedule and provides procedures for trouble-shooting an instrument malfunction.

CAUTION: Maintenance personnel should be thoroughly familiar with instrument operation before performing maintenance. It is essential that all portions of this manual relating to safety of operation, servicing and maintenance, be thoroughly understood. There should be no potential igniters or flame in the area when filling, emptying or purging the hydrogen system and the instrument should be turned off.

Extreme care should be exercised to ensure that required parts replacement is accomplished with the parts specified by Foxboro. NO MODIFICATIONS ARE PERMITTED. DISASSEMBLE INSTRUMENT ONLY IN A NON-HAZARDOUS ATMOSPHERE.

Routine Maintenance (Refer to Figure 5)

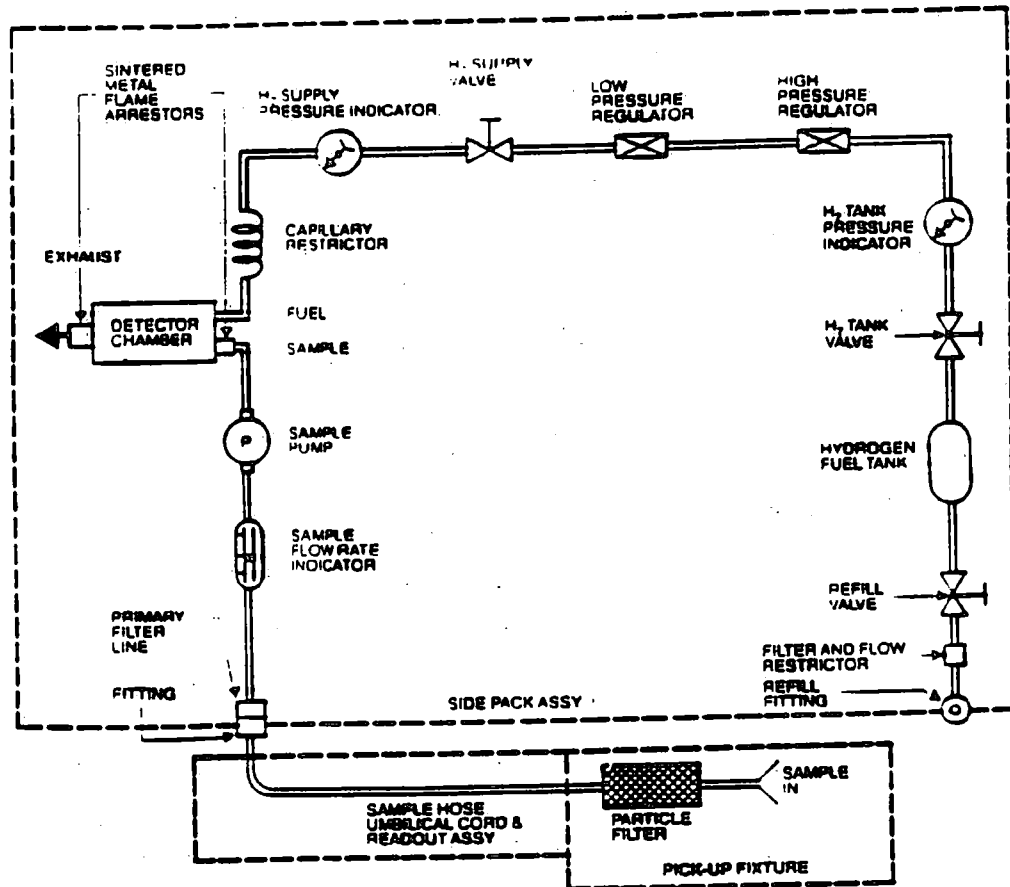


FIGURE 5
BLOCK DIAGRAM - GAS HANDLING SYSTEM

Primary Filter

This filter is located behind the sample inlet connector (Fitting Assembly) on the Side Pack Assembly and is removed for cleaning by using a 7/16 inch thin wall socket to unscrew the Fitting Assembly. The filter cup, "O" ring and loading spring will then come out. The porous stainless filter cup can be cleaned by blowing out or washing in solvent. If a solvent is used, care should be taken to ensure that all solvent is removed by blowing out or heating the filter. Reassemble in reverse order ensuring that the "O" ring seal on the Fitting Assembly is intact.

Secondary Filter

A particle filter is located in each pick-up fixture. One of these filters must be in the sample line whenever the instrument is in use. The OVA 128 uses a porous metal filter which can be replaced or cleaned.

Mixer/Burner Assembly Filter

A porous metal particle filter is incorporated in the Mixer/Burner Assembly which screws into the Preamp Assembly. This filter is used as the sample mixer and inlet flame arrestor in the chamber. The filter should not become contaminated under normal conditions but can be cleaned or the assembly replaced if necessary.

Access to this filter or output surface does not require removing the instrument from the case. For access, remove the safety cover using a hex key wrench (supplied) then unscrew the exhaust port. The Filter Assembly can now be seen on the side of the chamber (Preamp Assembly) and can be cleaned with a small wire brush.

Exhaust Flame Arrestor

A porous metal flame arrestor is located in the exhaust port of the detector chamber (Preamp Assembly). It acts as a particle filter on the chamber output and restricts foreign matter from entering the chamber. This filter may be cleaned by removing the exhaust port. For access, see Mixer/Burner section above. Note that the filter is captive to the exhaust port. Clean the filter with a solvent or detergent and ensure that it is dry and completely baked out at 120°F before reinstalling.

Sampling Fixtures

Sampling fixtures should be periodically cleaned with an air hose and/or detergent water to eliminate foreign particle matter.

If a solvent is used, the fixture should be subsequently cleaned with detergent and baked out at 120°F to eliminate residual hydrocarbons from the solvent.

Hydrogen Tank Supply & Refill Valves

After some time, the Teflon washers under each valve packing nut can "cold flow" (move with pressure) and allow hydrogen to leak. Leakage can be determined by using Leak-Tec, Snoop or a soap solution around the valve stems. This leakage can usually be stopped by tightening the compression nut (adapter) as outlined below.

- a) Unscrew the packing nut with a 7/16 inch wrench
- b) Unscrew the valve
- c) Replace the compression rings

This compression is against soft material and only a small amount of force is necessary to sufficiently compress the Teflon washers. If, after tightening, leakage still occurs, it would be advisable to replace the two Teflon washers, as follows:

- a) Drain hydrogen system slowly and to the extent necessary to work on the leaking valve(s). Observe safety precautions. There should be no potential igniters in the area.
- b) Remove all three (3) knob screws and knobs.
- c) Remove the compression nut on the valve that is not sealing properly. Remove the stem by unscrewing it from the valve body. Observe the sandwich of metal and Teflon washers and note their order.
- d) Visually check the Kel-F™ seat on the stem for cracks or foreign material. Wipe clean, if necessary, with a lint free cloth (no solvents or oils) and replace if damaged.
- e) Remove the washers and replace the Teflon washers (the factory procedure is a light wipe of HYDRO-CARBON FREE silicone grease).
- f) Replace the stem assembly in the valve body and tighten lightly.

- 3) Push the washers down into the compression area in the same order as noted upon removal. Replace the compression nut and tighten snugly.
- 4) Close the low pressure valve and fill the tank assembly. Check valves for leaks. Tighten again, if necessary, and reassemble the unit.

Air Sampling System Maintenance

A potential problem associated with the OVA instrument is that leaks can develop in the air sample pumping system. These leaks can result in dilution or loss of sample, causing low reading of vapor concentration and slow response.

The OVA is equipped with a flow gauge that provides a method to check for air leaks. Assemble the pickup probe selected for use to the readout assembly and then position the sidepack vertically so the flow gauge may be observed. Cover the end of the pickup probe with your finger and observe that the ball in the flow gauge goes to the bottom, indicating no air flow (if ball has slight chatter while on bottom, this is acceptable). Cover the center of the chamber exhaust port with your thumb and again observe the ball going to the bottom. Another simple check is to expose the pickup probe to cigarette smoke or a light vapor (butane) and observe that the meter responds in approximately 2.0 seconds. It should be noted that slow meter response may also indicate a restriction in the air sampling system.

Failure of the ball to go to the bottom when the inlet is blocked indicates a leak in the system between the probe and the pump inlet or the inlet check valve. To isolate the problem, remove parts, one at a time, and again block off the air inlet. Remove the pickup probe(s) and cover the air inlet at the Readout Assembly. If the ball goes to the bottom, check that the "readout to probe" seal washer is in place and replace the probes, holding them back against this seal while tightening the nut. Recheck, and if leakage is still present, it is probably in the probe (pickup fixture), which should be repaired or replaced.

If leakage is indicated as being past the readout handle when the connection to the sidepack is tight, disconnect the sample line at the fitting on the sidepack and cover this inlet with your finger. If the flow gauge ball goes to the bottom, the problem should be a leak in the umbilical cord/Read-

out Assembly, which should be investigated and repaired. There is also the possibility of a leaking check valve in the pump which would not show up on this test. If the leakage is not found in the umbilical cord, it is most likely in the pump check valve. The pump should be replaced.

If the ball does not go to the bottom, the leak will be either in the flow gauge or it's connecting tubing. Visually check that the tubing is connected and if so, the flow gauge should be repaired or replaced. Check the "O" ring installation in the sample inlet connector (Fitting Assembly).

As an alternate approach, leaks on the inlet side of the pump can be detected by using alcohol on a "Q" Tip and lightly swabbing the connections one at a time or by directing organic vapor or smoke at the potential leakage points and observing the meter response or audible alarm.

Leaks (beyond the pump) are easier to locate, as any of the commercially available leak detection solutions can be used. Cover the exhaust port, which will place the exhaust system under pressure, and check each connection, one at a time. Replace the Teflon tubing or retape the threaded connections with Teflon joint tape. Check the igniter and Mixer/Burner Assembly where they screw into the detector, the high voltage terminal screw on the side of the Mixer/Burner and exhaust port itself. If after these checks, the flow gauge ball still will not go to the bottom with the exhaust blocked, the problem is likely a leaking exhaust check valve in the pump, which should be repaired or replaced.

Contaminating Control

On occasion, the background reading may be relatively high under normal ambient conditions. Ambient background readings will vary somewhat depending on the geographical location where the instrument is being used. However, the background reading normally should be in the range of 3 to 5 ppm as methane. The acceptable background reading consists of 1 to 14 ppm of methane which is present in the normal air environment. In addition to the measurement of a normal methane background, there will normally be 2 to 4 ppm of equivalent methane background caused by acceptable levels of contamination in the hydrogen fuel and/or hydrogen fuel handling system resulting in a total equivalent methane reading of 3 to 5 ppm in clean air.

If the background reading goes above 5 ppm to 6 or 7 ppm, this is normally still acceptable since any measurement is additive to that background reading, i.e., 2 ppm on top of 5 or 2 ppm on top of 7 provides the same differential reading. However, the lower background is obviously desirable.

The background reading is zeroed out or nulled - even though in reality the background still exists. The background reading is measured by zeroing the meter with the flame out and noting the meter indication after the flame is on.

The cause for a high background reading is usually associated with contamination in the hydrogen fuel system. This will, of course, cause a background reading since this is the function of the basic detector "to measure contamination entering the detector chamber". In addition, contamination present in the hydrogen will many times leave a small unobservable deposit on the burner face which can continue to generate a background reading when the detector is in operation and the burner assembly is heated.

Another possible cause of contamination is the Mixer/Burner Assembly when the contamination is trapped in the porous bronze sample filter. This is not a common problem and usually only happens when an unusually high level of contaminant is drawn into the assembly. Another possible cause of high background reading is contamination in the air sample line to the detector. This is uncommon but can be the source of the problem.

NOTE: An OVA that has the Chromatograph have high background saturation of the activated charcoal filter, which is in the line during chromatograph analysis, or of the column which is in the hydrogen line at all times.

Analysis and Correction

Prior to analyzing the problem, the OVA should be checked for proper electronic operation. It should be ensured that the instrument is calibrated to methane as referenced.

If, after checking that the OVA is properly calibrated, the background is still higher than normal for ambient conditions, the following procedure should be followed to isolate the cause of the problem:

- a) Let the OVA run for a period of time (15 to 30 minutes) and see if the background level decreases as a function of time. The background could go down as a result of clearing line contamination which is removable simply by the normal flow of air through the sample line.
- b) Take a reading in a known, relatively clean air environment. Normally, outside air environment is clean enough to assess by comparison whether the background reading is internal to the instrument or is present in the location where the instrument is being used.
- c) If the OVA has the Gas Chromatograph Option, depress the sample inject valve, so that the activated charcoal is in the line, and observe whether the background reading goes down and stays steady after elution of the air peak. The reading should always go down or stay the same but never increase when the sample valve is depressed, since the charcoal filter will remove trace elements of organic vapors in the air sample heavier than C₂. If another activated charcoal filter is available, this may be attached to the end of the probe to scrub the air so that a clean air sample is supplied to the detector. The external activated charcoal filter can be used on any instrument, with or without chromatograph, for providing a clean air sample to assess background level.
- d) If the background cannot be reduced by any of the previous steps, remove the safety cover and the exhaust port of the detector chamber (on the bottom of the case) and clean the cavity and the electrode using the small wire brush supplied with the analyzer. This will remove any small quantities of contamination which could be the source of the background vapor. After cleaning, replace the exhaust port and safety cover and reignite the OVA. If detector contamination was the cause, the problem should be immediately resolved and the ambient background will drop to an acceptable level.

- e) If the high background is still present, the various parts of the sample flow line such as pickup probes, umbilical cord to the instrument, etc., should be investigated by the process of elimination to see if the contamination can be isolated.

Serious contamination in the air sample line is very uncommon, however, if very large doses of low vapor pressure compounds are sampled, there is a possibility of residual contamination. This would eventually clear itself out but may take a considerable period of time. A typical cause for high background from the sample line is a contaminated Mixer/Burner Assembly. If heavy contamination of the Mixer/Burner is indicated, replace the Mixer/Burner Assembly.

- f) In the event of contamination in the pump or other internal parts of the sample flow lines which cannot be removed, the sample flow components have to be disassembled and cleaned. This is normally a factory operation, however, components such as the pump can be replaced in the field along with any contaminated tubing.
- g) High background readings on OVA's which include the Gas Chromatograph Option can be caused by other sources of contamination. If the charcoal filter mounted on the instrument panel is saturated, contaminated air would be supplied to the detector and raise the ambient level background. To check for this, refill the cartridge with fresh charcoal, Foxboro P/N CSU004. This would determine if the charcoal was the source of the background reading. It is also possible that a high background reading could be due to contamination in the column. This could be caused by compounds slowly eluting from a column which has become contaminated. The easiest way to check for column contamination is to replace the column with a clean column or a short empty piece of column tubing and see if the high background reading drops.

- h) If the above steps do not correct the high background, the cause will normally be contamination in the hydrogen fuel system.

Contamination in the hydrogen fuel system is usually the direct result of contaminated hydrogen gas or contamination introduced during the filling operation. Filling hose contamination can be caused by scoring the hose in a contaminated area.

To remove contamination, the fuel system should be purged with hydrogen. Effective purging is accomplished by disconnecting the capillary tube fitting to the manifold block which has the low pressure gauge (Hydrogen Supply Pressure Gauge and Hydrogen Supply Valve). This disconnects the capillary tubing from the hydrogen line so that hydrogen may be purged at a reasonable rate from the tank assembly through the regulators, gauges and valves. After disconnecting the capillary, the hydrogen tank can be filled in the normal manner. The tank valve and hydrogen supply valve can then be opened which will bleed the hydrogen from the tank through the hydrogen fuel system, purging contamination which is in vapor form. There is the possibility that contamination has been introduced into the hydrogen fuel system which is not readily purged by the hydrogen gas, but this is unlikely. After purging with clean hydrogen two or three times, the capillary tube should be reconnected and the background again checked. Five or ten minutes should be allowed before assessing the background reading, since contaminated hydrogen can be trapped in the capillary tube.

If another clean instrument is available, the fuel system from the clean instrument can be connected to the contaminated instrument to verify whether the problem is associated with the hydrogen fuel supply system. The interconnection should be made to the capillary tube of the contaminated instrument.

Troubleshooting

Table 1 presents a summary of field troubleshooting procedures. If necessary, the instrument can be easily removed from the case by unlocking the four (4) 1/4 turn fasteners on the panel face and removing the refill cap. The battery pack is removed by taking out the four (4) screws on the panel and disconnecting the power connector.

Factory Maintenance

To ensure continuous trouble-free operation, a periodic factory maintenance, overhaul, and recalibration is recommended. The recommended schedule is every six to nine months. This maintenance program includes replacement of plastic seals and parts as required, pump overhaul, motor check, sample line cleaning, hydrogen leak check, recalibration, and detailed examination of the unit for any other required maintenance and repair.

Recommended Spare Parts

Item	Description	Part Number	Recommended Quantity
1	Igniter	510461-1	2
2	Pump Assembly	510223-6	1
3	Cup, Filter (3/8 inch OD, ss)	510318-1 (5/pkg.)	1
4	Mixer/Burner Assembly	510513-1	1
5	Wafer, Teflon, H ₂ Valve	510160-1 (10/pkg.)	1
6	Washer, Brass, H ₂ Valve	510160-2 (10/pkg.)	1
7	Exhaust Port Assembly	510530-1	1
8	Battery Pack Assembly	510542-1	1
9	Sample Line Assembly	510316-1	1
10	Particle Filters	510116-1	1

TABLE 1

PROBLEM	TROUBLE SHOOTING PROCEDURE	REMEDY
1) Low sample flow rate on flow indicator. Nominally 2 units on flow gauge. (See also 6 below)	<p>a) Check primary filter in sidepack and particle filters in the pickup assembly.</p> <p>b) Determine assembly containing restriction by process of elimination, i.e., remove probe, remove Readout Assembly, remove primary filter, etc.</p> <p>c) If the restriction is in the Side Pack Assembly, further isolate by disconnecting the sample flow tubing at various points, i.e., pump output chamber, etc.</p> <p>NOTE: The inherent restrictions due to length of sample line, flame arrestors, etc., must be taken into account when trouble-shooting.</p>	<p>Replace or clean filter if clogged.</p> <p>Investigate the assembly containing this restriction to determine cause of blockage. Clean or replace as required.</p> <p>If in the detector chamber, remove and clean or replace porous metal flame arrestors. If pump is found to be the problem, remove and clean or replace.</p>
2) Hydrogen flame will not light. (See also 6 below)	<p>a) Check sample flow rate (see 1 above)</p> <p>b) Check igniter by removing the chamber exhaust port and observing the glow when the IGNITE BUTTON is depressed.</p> <p>c) Check for rated Hydrogen Supply Pressure. (Listed on calibration plate on pump bracket).</p> <p>d) Check hydrogen flow rate by observing the psi decrease in pressure on the Hydrogen Tank Pressure gauge. The correct flow rate will cause about 130 psi decrease in pressure per hour. (Approximately 12 cm³/min at detector).</p> <p>e) Check all hydrogen plumbing joints for leaks using soap bubble solution. Also, shut off all valves and note pressure decay on hydrogen tank gauge. It should be less than 350 psi per hour.</p>	<p>If sample flow rate is low, follow procedure 1 above.</p> <p>If igniter does not light up, replace the plug. If igniter still does not light, check the battery and wiring.</p> <p>If low, remove battery pack and adjust to proper level by turning the allen wrench adjustment on the low pressure regulator cap.</p> <p>The most likely cause for hydrogen flow restriction would be a blocked or partially blocked capillary tube. If flow rate is marginally low, attempt to compensate by increasing the Hydrogen Supply Pressure by one-half or one psi. If flow rate cannot be compensated for, replace capillary tubing.</p> <p>Repair leaking joint.</p>

TABLE 1

PROBLEM	TROUBLE SHOOTING PROCEDURE	REMEDY
	<p>f) Check to see if hydrogen supply system is frozen up by taking unit into a warm area.</p> <p>g) Remove exhaust port and check for contamination.</p> <p>h) Check spacing between collecting electrode and burner tip. Spacing should be 0.1 to 0.15 inches.</p>	<p>If there is moisture in the hydrogen supply system and the unit must be operated in subfreezing temperatures, purge the hydrogen system with dry nitrogen and ensure the hydrogen gas used is dry.</p> <p>If the chamber is dirty, clean with ethyl alcohol and dry by running pump for approximately 15 minutes. If hydrogen fuel jet is misaligned, ensure the porous metal flame arrester is properly seated.</p> <p>Adjust by screwing Mixer/Burner Assembly in or out. This spacing problem should only occur after assembling a Mixer/Burner Assembly to a Preamp Assembly.</p>
3) Hydrogen flame lights but will not stay lighted.	a) Follow procedures 2(a), (c), (d), (e), (g) and (h) above. Also refer to 5 below.	
4) Flame-out alarm will not go on when hydrogen flame is out.	<p>a) Check instrument calibration setting and GAS SELECT control setting.</p> <p>b) Remove exhaust port and check for leakage current path in chamber (probably moisture or dirt in chamber).</p> <p>c) If above procedures do not resolve the problem, the probable cause is a malfunction in the preamp or power board assemblies.</p> <p>d) Check that volume control knob is turned up.</p>	<p>Readjust as required to proper setting. Note that the flame-out alarm is actuated when the meter reading goes below zero.</p> <p>Clean contamination and/or moisture from the chamber using a swab and alcohol. dry chamber by running pump for approximately 15 minutes.</p> <p>Return preamp chamber or power board assembly to the factory for repair.</p> <p>Adjust for desired volume.</p>

TABLE 1

PROBLEM	TROUBLE SHOOTING PROCEDURE	REMEDY
5) False flame-out alarm.	a) Flame-out alarm is actuated when signal goes below electronic zero (with flame on). This can be due to inaccurate initial setting, drift, or a decrease in ambient concentration. Verify if this is the problem by zeroing meter with flame out and rezeroing.	When using the X1 range adjust meter to 1 ppm, rather than zero, be sure instrument has been zeroed to "lowest expected ambient background level".
6) Slow response, i.e., time to obtain response after sample is applied to input is too long.	a) Check to ensure that probe is firmly seated on the rubber seal in the readout assembly. b) Check sample flow rate per procedure 1 above.	Reseat by holding the probe firmly against the rubber seat and then lock in position with the knurled locking nut. See 1 above.
7) Slow recovery time, i.e., too long a time for the reading to get back to ambient after exposure to a high concentration or organic vapor.	a) This problem is normally caused by contamination in the sample input line. This requires pumping for a long period to get the system clean of vapors. Charcoal in the lines would be the worst type of contamination. Isolate through the process of elimination. (See 1(b)). b) Check flame chamber for contamination.	Clean or replace contaminated sample line or assembly as required. Clean as required.
8) Ambient background reading in clean environment is too high.	a) A false ambient background reading can be caused by hydrocarbon in the hydrogen fuel supply system. Place finger over sample probe tube restricting sample flow and if meter indication does not go down significantly the contamination is probably in the hydrogen fuel. b) A false ambient background reading can also be caused by a residue of sample building up on the face of the sample inlet filter. If the test in 8(a) above produces a large drop in reading, this is usually the cause.	Use a higher grade of hydrocarbon free hydrogen. Check for contaminated fittings on filling hose assembly. Remove the exhaust port (it is not necessary to remove instrument from case). Use the small wire brush from the tool kit or a knife blade and lightly scrub surface of sample inlet filter.

TABLE 1

PROBLEM	TROUBLE SHOOTING PROCEDURES	REMEDY
	<p>c) A false ambient background reading can also be caused by hydrocarbon contamination in the sample input system. The most likely cause would be a contaminant absorbed or condensed in the sample line. NOTE: It should be emphasized that running the instrument tends to keep down the buildup of background vapors. Therefore, run the unit whenever possible and store it with the carrying case open in clean air.</p>	Clean and/or replace the sample input lines. Normally the false reading will clear up with sufficient running.
9) Pump will not run.	a) Check that there is no short circuit in wiring.	If no short circuit, pump motor is defective.
10) No power to electronics but pump runs.	a) Short circuit in electronics.	There is a short in the electronics assembly. Return OVA to factory or authorized repair facility.
11) No power to pump or electronics	a) Place battery on charger and see if power is then available. Recharge in a non-hazardous area only.	If power is available, battery pack is dead or open. Recharge battery pack. If still defective, replace battery pack.

GAS CHROMATOGRAPH (GC) OPTION

The Model OVA 128 CENTURY Organic Vapor Analyzer provides efficient and accurate indication of total organic compound concentrations on a continuous sampling basis. However, in areas where mixtures of organic vapors are present, it often becomes necessary to determine the relative concentration of the components and/or to make quantitative analysis of specific compounds.

To provide this capability, a gas chromatograph (GC) option is available. See Figure 6 for the location of the major components and controls associated with the GC option. When the GC option is used, the capability of the OVA includes both qualitative and on-the-spot quantitative analysis of specific components present in the ambient environment. The Recorder, which is used with the GC option, is described separately.

This section is applicable only to an OVA with the optional gas chromatograph system.

Modes of Operation

The OVA with GC option has two modes of operation. The first mode is the measurement of total organic vapors in the same manner as described for the basic OVA instrument. This mode is referred to as the "Survey Mode". The OVA is in the "Survey Mode" of operation whenever the Sample Inject Valve is in the "out" position.

The second mode of operation is called the "GC Mode". The OVA is in this mode of operation any time a sample has been injected into the GC system and the sample is being transported through the GC column. This section provides a brief description of how a gas chromatograph (GC) operates and specifically, how the Model OVA 128 performs the required operations. A comprehensive discussion of gas chromatography theory, column selection, and data analysis is beyond the scope of this manual.

The OVA with GC option can be utilized for many types of analysis in the outdoor or indoor ambient environment or for specific laboratory type analysis. The OVA was not designed to compete with the research or process gas chromatograph but to compliment these instruments or eliminate their need in field applications.

This manual is intended to provide the operator with information to operate and maintain the OVA. Forboro publishes a series of Technical Notes to assist the operators in applying the instrument to field monitoring situations.

All flow visualization detector (FID) gas chromatographs require certain elements for their operation. These elements include three flow regulated gas supplies as follows: 1) A carrier gas to transport the sample through the column; 2) Hydrogen gas for operation of the FID; 3) A clean air supply to support combustion to the FID. In addition, a method for injecting a known volume of sample air (aliquot) to be analyzed is required.

In standard gas chromatographs these three (3) flow regulated gases are individually supplied from pressurized cylinders equipped with regulators and flow control apparatus. The Model 128 GC system differs in that the hydrogen fuel for the FID is also used as the carrier gas. The clean air supply is simply the normal air sample pumped to the FID. During the GC analysis, this air is scrubbed in a charcoal filter to provide the clean air supply. The end result is that no additional gas supplies are required to add the GC option to the basic OVA instrument.

A valving arrangement is incorporated to provide a method for transferring a fixed volume of air into the GC system for analysis. The sample air injected into the GC column is the same sample being analyzed by the OVA for total organic vapor concentration. Therefore, the instrument provides the unique capability to observe the total organic vapor concentration of the sample prior to injecting it into the GC system. This operating feature is invaluable in field work where the environment is continually changing and where valuable GC analysis time must be expended only on the sample of concern.

OVA Columns

Columns are available in 4, 8, 12, 24, 36 and 48 inch lengths as standard offerings with any of the column packings listed below. Longer lengths are available in 12-inch increments on a non-standard basis. To order a column simply use the general part number for a column which is 510454 followed by a dash (-), the Foxboro packing material designation, a second dash and the desired length in inches. A sample column designation is 510454-G-24. This would represent a 24 inch column with 10% OV 101 on Chromosorb W, HP 60/80 mesh. If a specific application arises which calls for a column material not listed below, please contact Foxboro. We will be happy to check on its availability.

<u>Foxboro Designation</u>	<u>Material</u>
A	20% Dioctyl Phthalate on Chromosorb-P, AW 60/80 Mesh
C	Chromosorb 101, 60/80 Mesh
D	20% Ucon 50 HB 280 on Chromosorb-P, AW 60/80 Mesh
E	20% Carbowax 400 on Chromosorb-P, AW 60/80 Mesh
F	5/1.75% Diethylhexyl Sebacate/mentone 34 on Chromosorb W, AW 60/80 Mesh
G	10% OV-101 on Chromosorb W, HP 60/80 Mesh
T	10% 1,2,3-Tris (2-cyanoethoxy) Propane on Chromosorb P, AW 60/80 Mesh
B	1% Diisodecyl Phthalate on Chromosorb W, AW 60/80 Mesh
PT	Poropak T, 60/80 Mesh
Q	Poropak Q, 60/80 Mesh
H	20% Carbowax 20M on Chromosorb P, AW 60/80 Mesh
J	n-Octane on Porasil C, 80/100 Mesh
N	Poropak N, 60/80 Mesh

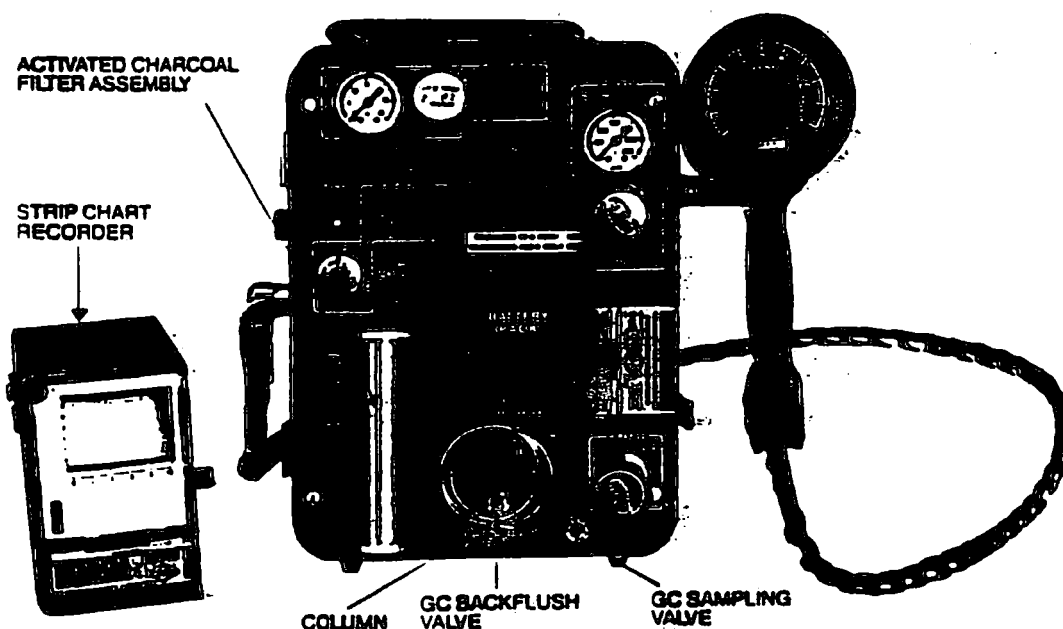


FIGURE 6
ADDITIONAL CONTROLS & COMPONENTS - GC OPTION

Sample Flow

Figure 7 is a flow diagram illustrating the flow paths of the hydrogen fuel, sample air supply, and GC injected sample aliquot.

Two push-bull valves are used in the GC system: the Sample Inject Valve and the Backflush Valve.

Block D illustrates the flow paths with the Sample Inject Valve in the "out" position. With this valve in the "out" position, the OVA functions in its normal manner as a total organic vapor analyzer.

Block C illustrates the flow paths after the Sample Inject Valve is moved to the "in" position to initiate the GC Mode.

The hydrogen flow path is now through the sample loop which enables hydrogen to sweep the air sample from the loop and carry it through the GC column.

Also note that the sample air going to the FID chamber is now routed through the activated charcoal filter where essentially all organic vapor contamination is removed from the air. The activated charcoal filter will effectively absorb most organic vapors with the exception of methane and ethane. The functions of the Sample Inject Valve are, therefore, to transfer a fixed volume sample of the air being monitored into the hydrogen stream and to reroute the sample air supply through a filter (scrubber).

The Backflush Valve has no prepositioning requirement to function. It can be in either the "in" or "out" position at the time a sample is injected into the GC system for analysis. The Backflush Valve simply reverses the direction of the hydrogen flow through the GC column.

Regardless of the operating mode, hydrogen always flows through the column to the FID detector and the sample air supply always flows to the FID detector to provide oxygen for the hydrogen flame.

The recommended hydrogen flow rate is 12 cm /min for proper FID operation

and as a standard flow rate for generating GC reference/calibration data. This hydrogen flow rate is adjusted by varying the Hydrogen Supply Pressure, which is the hydrogen pressure at the input of the flow control capillary tube of the OVA. The pressure is changed by adjusting the set screw in the bonnet of the low pressure regulator, accessible by removing the battery pack from the instrument panel. To monitor the hydrogen flow rate, connect a bubble flowmeter to an end of the GC column which has been disconnected from the panel fitting and move the Backflush Valve so that hydrogen is flowing out of the column. Primary hydrogen flow control is accomplished by the capillary tube of the OVA. However, the flow restriction of a GC column will also affect the hydrogen rate and the effect will vary with column length, type of packing and packing methods. The nominal Hydrogen Supply Pressure is around 10 psig and the pressure drop across a typical 24 inch long column packed with 60/80 mesh material is approximately 1 to 1.5 psig. Normally, when the hydrogen flow rate is set at 12 cm /min with a standard 24 inch long column, no adjustment needs to be made when using columns from four (4) inches to four (4) feet long. Longer columns may require hydrogen flow adjustment for proper operation. Adjustment would be required if and when precisely controlled analysis was being conducted or when the hydrogen flow was too low to keep the flame burning.

The sample air flow rate is not adjustable and is nominally 1.0 liter/minute. This flow rate should remain relatively constant. A sample flow gauge is provided on the OVA panel to monitor the sample flow rate. (Note: Panel gauge is not calibrated in L/min). When the Sample Inject Valve is in the "in" position, there may be a slight increase or decrease in sample air flow rate (0 to 15%). This change will normally not affect operation of the instrument as long as the flow rate is consistent from analysis to analysis. Basically, if the flow rate is consistent between calibration and end usage, there will be suitable precision in the measurements.

GC Analysis

1) SAMPLE INJECTION

When the Sample Injection Valve is depressed, the air in the sample loop is injected into the hydrogen stream which transports the sample through the column for separation of its components and to the flame chamber for analysis. This small volume of injected sample is qualitatively analyzed based on the retention time of the individual components of that sample while passing through the column. Quantitative analysis can then be accomplished by peak height or peak area analysis methods.

2) THE COLUMN

The column consists of tubing packed with a material which physically interacts with organic vapors and retards the passage of the vapors through the column. Since the packing material has a different attraction for each organic substance, each component in a mixture of gases will be slowed down to a different extent.

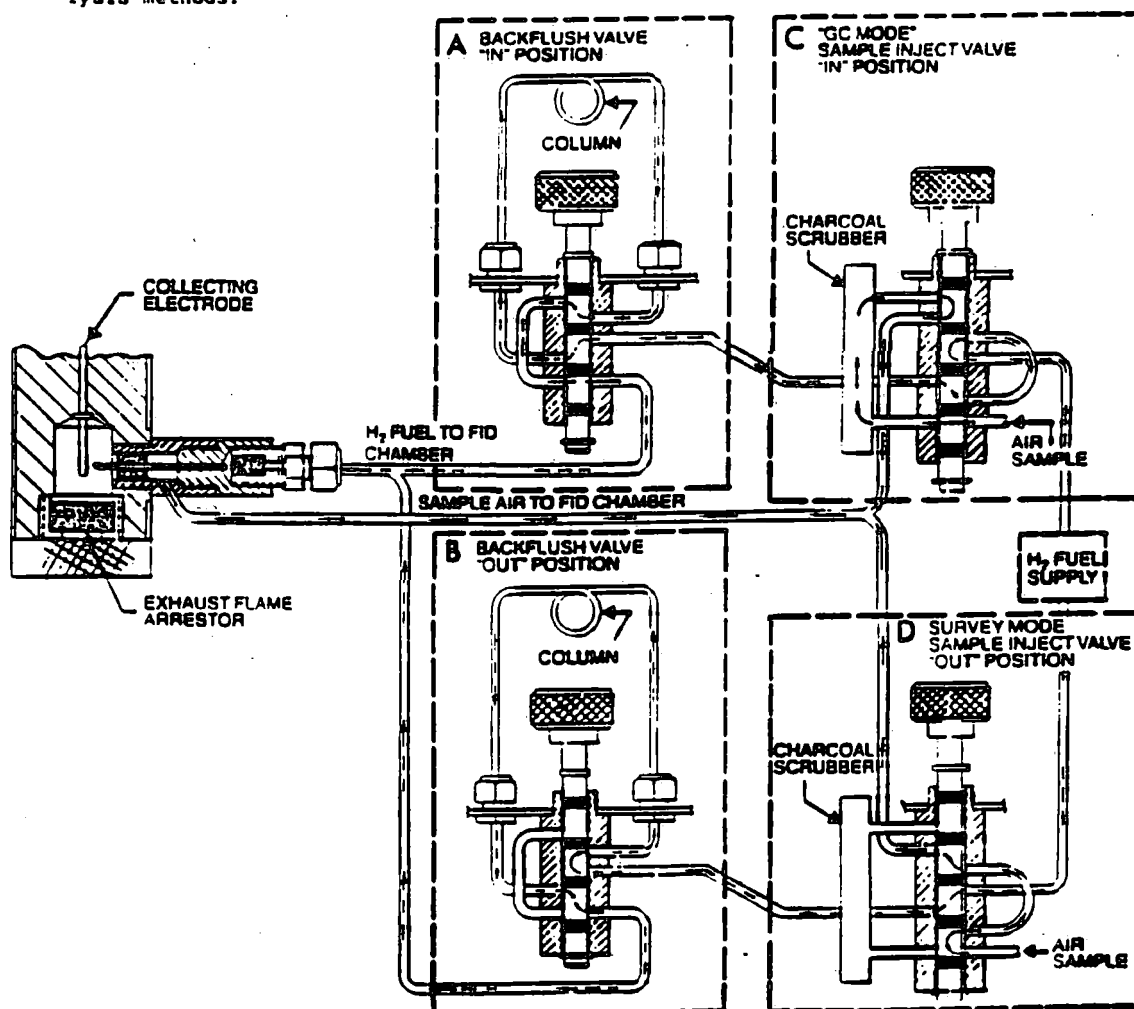


FIGURE 7
FLOW DIAGRAM - GC OPTION

The net effect is that each component elutes from the column at a different time. The components are then fed to the detector which gives a response to the meter or to an external strip chart recorder.

A portable isothermal pack (PIP) can be used for temperature control and/or isothermal analysis. This is described further under PIP kit option.

3) QUALITATIVE ANALYSIS

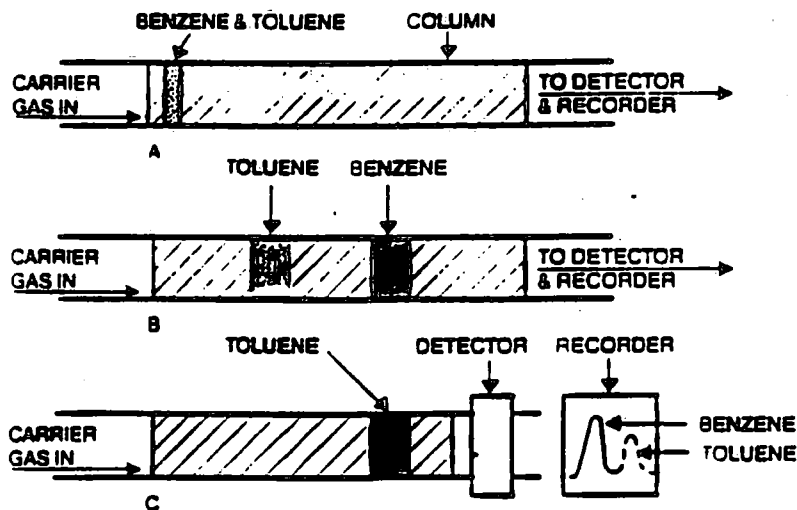
As each organic substance has a unique interaction with the column packing material, the time that the substance is retained on the column is also unique and thus characteristic of that particular substance. The "retention time" (RT) is primarily dependent on the type of packing material, the length of the column, the flow rate of the gas carrying the mixture through the column and the temperature range of the system.

When these variables are controlled, the retention times can be used to identify each of the components in a mixture. Because of these variables, it is usually necessary to establish retention times for each instrument by making a test with the pure substances of interest or to refer to established time data charts prepared in advance for that specific instrument. In those cases where retention times of the components are too close together for a good analysis, an adjustment in one or more of the operating variables will effect a sufficient difference in retention times to enable meaningful analysis.

4) QUANTITATIVE ANALYSIS

The detector response to any organic component is proportional to the quantity of material passing through the detector at a given time. For an eluted component, a plot of concentration vs. time forms a bell-shaped curve.

When using a strip chart recorder, the curve drawn on the paper is triangularly shaped and the area under the peak is related to the amount of substance being analyzed.



PICTORIAL SEPARATION OF BENZENE AND TOLUENE - "A" AT BEGINNING OF SEPARATION; "B" DURING SEPARATION; "C" BENZENE HAS ALREADY PASSED THE DETECTOR AND IS RECORDED. TOLUENE (DOTTED LINES) WILL APPEAR ON RECORDER AS IT PASSES THE DETECTOR.

FIGURE 8
TYPICAL COLUMN SEPARATION SEQUENCE

5) BACKFLUSH

The column Backflush Valve is provided to reverse the flow of the carrier gas (hydrogen) through the column. It is necessary that the column be backflushed after each individual analysis except under certain special conditions. The primary purpose of the backflush function is to clear the column of heavy compounds (with long retention times) which would contaminate the column and cause interferences to future GC analysis. The Backflush Valve has no prepositioning requirement; it is reversed from either position it was in during GC analysis. The Backflush Valve should be actuated immediately after the peak of the last compound of interest elutes. Figure 8 illustrates the function of the Backflush Valve.

In the GC system, the backflush is "to the detector". This is possible because the carrier gas and detector fuel are the same, i.e., hydrogen. It provides a convenient means of quantifying the total compounds in the backflush by simply recording the peak that elutes during the backflush operation. For field instruments, this quantitative backflush information is valuable since it provides a direct means of observing the condition of the column and seeing when the column is clean and the detector response has returned to baseline. The time required for the backflush is usually 1.2 to 1.5 times the GC analysis time.

6) SURVEY TO GC MODE

There is an inherent advantage to integrating the GC system to the basic total Organic Vapor Analyser (OVA). The OVA provides a direct reading of total organic vapors in the air being sampled, which gives the operator information about the sample being injected into the GC system. This information can be used to predict and verify the peaks that result during the GC analysis, including the backflush peak.

This feature eliminates expending valuable GC analysis time where there is no contamination of concern (comparable to taking noise measurements in quiet corners). It also enables the operator to select the most appropriate location to conduct an analysis, normally the area of highest concentration.

GC MODE OPERATING PROCEDURES

The gas chromatographic analysis mode (GC Mode) of operation can be initiated at any time during a survey by simply depressing the Sample Inject Valve. After completion of the analysis and backflush operations, the Sample Inject Valve is pulled out and the survey continued or another sample injected. Note that when the Sample Inject Valve is in the survey mode (out position) the OVA operates in the same manner as an OVA which does not incorporate the GC option.

Controls/Indicators

Refer to Figure 4.

- 1) Sample Inject Valve - This two (2) position valve (shown schematically in Figure 7) is used to select either Survey Mode (valve out) or GC Mode (valve in).
- 2) Backflush Valve - This two (2) position valve (shown schematically in Figure 7) is used to reverse the flow of hydrogen through the column to:
 - a) Backflush the column for cleaning.
 - b) Quantitatively measure total compounds after a selected point. Example: Separation of methane from non-methane hydrocarbons to read total non-methane hydrocarbon level.
- 3) Column - Separates components of a gas mixture so that each component of the mixture elutes from the column at a different time.
- 4) Activated Charcoal Filter Assembly - This assembly functions only in the GC Mode (Sample Inject Valve "in") as shown schematically in Figure 7. It removes organic compounds (except methane and ethane) by absorption from the sample air supply.

Turn on Procedure

Place the Sample Inject Valve in the "out" position and put the OVA instrument in operation per "Operating Procedures" for the survey mode. NOTE: Leave the hydrogen fuel and pump "on" for three (3) to four (4) minutes before attempting ignition to allow time for hydrogen purging of the column.

Survey Mode

When using the OVA in the Survey Mode, ensure that the Sample Inject Valve remains in the full "out" position and that the Backflush Valve is either full "in" or full "out". Note that when changing from the GC Mode to the Survey Mode, the OVA output reading will continue to change until all compounds have been eluted from the GC column. Therefore, under normal field conditions, the GC column should be backflushed for clearing, which takes approximately 1.2 to 1.5 times the forward analysis time. The backflush peak may be observed returning to baseline, after which the Sample Inject Valve may be moved to the Survey Mode (out) position.

When the compound(s) being analyzed are known to be the only compound(s) present in the air sample, backflushing may be omitted.

GC Mode Operation

In normal GC analysis, a strip chart recorder is used to record the output concentration from the OVA as a function of time. This record, called a chromatogram, is utilized for interpretation of the GC data.

a) OPERATION

- 1) Turn on recorder and push Sample Inject Valve "in" with a fast, positive motion. This starts the GC analysis which is automatic up to the point of backflushing. NOTE: Rapid and positive motion should be used when moving either the Sample Inject or Backflush Valves. On occasion, the flame in the FID detector may go out, which would be indicated by a sharp and continued drop of the concentration level. If this occurs, reignite the flame and continue the analysis. NOTE: A negative "air" peak typically occurs shortly after sample injection and should not be confused with flame-out.
- 2) The negative air peak and various positive compound peaks indicated on the OVA readout meter and the strip chart recorder represent the chromatogram.

3) After the predetermined time for the analysis has elapsed (normally immediately after the peak of the last compound of concern), rapidly move the Backflush Valve to its alternate position (in or out). Leave the instrument in this condition until the backflush peak returns to baseline, then pull the Sample Inject Valve to the "out" position. If no backflush peak appears, pull the Sample Inject Valve out after being in the backflush condition for a period at least twice as long as the analysis time. The OVA is now in the Survey Mode and ready for survey or injection of another sample into the GC system.

b) INTERPRETATION OF RESULTS

The OVA 128 with GC option is intended for applications where there are a limited number of compounds of interest and the compounds are normally known. Under these conditions, the operator must know the retention time and peak height characteristics of the compounds under specific operating conditions. To calibrate the OVA in the GC Mode, determine, by test, the retention time and peak area (using peak height analysis) for the compounds of concern. These tests should be conducted on the column to be utilized and over the concentration and temperature range of concern. When representative characteristic data is available, such as in the Application/Technical Notes, a spot calibration check is normally all that is required.

It should be noted that under normal field conditions, the vapor concentrations vary continually as a function of time, location, and conditions. Field measurements for industrial hygiene work are normally associated with a threshold level around a pre-established concentration. Surveys for locating fugitive emission sources present a continually varying situation. Under these conditions, it is desirable to have a simple method of interpreting the GC data for on-the-spot analysis and decision making.

High precision is normally not a requirement for these type analyses since the environment is continually changing. The methods presented in this section are designed to provide a means for typical field analysis. When the OVA is used under laboratory conditions, standard laboratory methodology may be used for greater precision.

Technical Discussion

The chromatogram is a chart recorder trace of the organic vapor concentration from the Organic Vapor Analyser (OVA) as a function of time. A typical chromatogram is illustrated in Figure 9 and is a series of triangular shaped peaks originating from and returning to a fixed baseline. Qualitative interpretation of a chromatogram involves identifying a peak by analyzing the time it took for the peak to appear after initial injection (referred to as retention time (RT)) and comparing this RT to reference data. Quantitative interpretation involves analyzing the area under the peak and relating this area to calibration data of peak area versus concentration for that specific compound under the conditions present during the GC analysis.

It can be seen that interpretation of a chromatogram requires the use of calibration reference data. GC reference data is always generated empirically, i.e., through tests. Foxboro Application/Technical Notes may be used as a reference for selecting columns and interpreting chromatograms. However, simple tests must be conducted to obtain the required reference data.

a) QUALITATIVE ANALYSIS

Under a given set of operating conditions the retention time is characteristic of that particular substance and can be used to identify specific compounds. It will be necessary to calibrate retention times by making tests with the pure compounds of interest.

The retention time (RT) is defined as that period of time from injection until the time of maximum detector response for each substance. Retention time is measured from the time of sample injection to the time the apex of the triangle shaped curve is obtained on the strip chart recorder. (See Figure 9). The strip chart recorder operates on a clock mechanism such that the distance along the baseline is proportional to time. While retention times are characteristic for each compound, it is possible that two materials could have the same retention times. Thus, if there is any question as to the identity of the vapor, it may be necessary to verify identification by retention times on different columns.

Use of a longer column will increase the retention times of those components it is capable of separating. The time between peaks will also be increased. This is especially useful if a component comes through too fast or if desired peaks are so close that they overlap.

b) COLUMN SELECTION

Two columns are supplied with the instrument. These are general purpose columns which are useful in a wide variety of applications. If they do not achieve separations for a particular application, it may be necessary to select other packing materials or longer columns. Foxboro will assist in this selection or prepare a custom column if necessary.

If columns are made by the user or purchased from other sources, ensure that the packing density does not cause too large a pressure drop. A large pressure drop can result in flame-out problems.

c) TEMPERATURE EFFECT ON RETENTION TIME

An increase in temperature will decrease column retention time (RT) and vice versa. Normally retention time (RT), as a function of temperature, changes linearly over the range of 0 to 40°C. For complex qualitative analysis, a calibration plot of RT versus temperature will be required. In typical usage, such as inside a factory, the effect of temperature can be compensated for during chromatogram interpretation. A single component tracer compound can be sampled at any time to provide a "key" for other compound identification.

d) CARRIER GAS FLOW RATE AFFECT ON RETENTION TIME

An increase in carrier gas flow rate will decrease retention time. For reproducible data, the carrier gas (hydrogen) flow rate must be recorded in association with a chromatogram. Primary control of the hydrogen flow rate is accomplished in the OVA by regulating the hydrogen pressure across a capillary tube. The hydrogen flow rate is also affected by the restriction of the GC column but most columns have a limited effect. The hydrogen flow rate is factory set at 12 cm/minute with a typical 24 inch column.

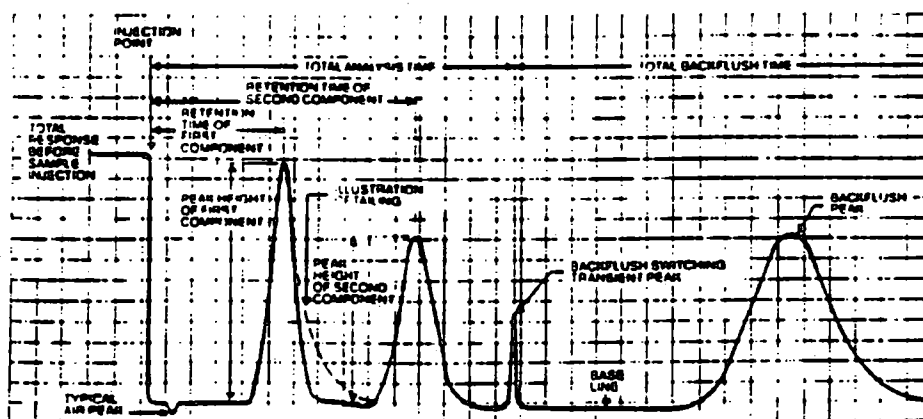


FIGURE 9
TYPICAL CHROMATOGRAM

e) QUANTITATIVE ANALYSIS

In general, the more triangularly symmetrical the peak, the better the peak height analysis capability. However, many GC peaks have "tailing" as illustrated in Figure 9. Peak height calibration is an acceptable method for quantitative analysis as long as the area under the tail is small compared with the total peak area. If severe tailing occurs, empirical calibration data generated through tests may be required to plot the peak height versus the concentration curve.

Only peak height analysis will be discussed in this manual. The method involves injecting a known concentration of the compound and recording the peak height under the test conditions. Peak height characteristics can be established for various columns and various temperatures. Normally, both retention time and peak height characteristics will be measured.

When peak area measurements are desired, the areas may be measured using an integrator on the OVA output signal. Other manual methods may also be used, such as counting squares, weighing curves or simple triangulation. When the GC peaks have good symmetry, triangulation (area equals $1/2$ base \times height) is a convenient method.

Calibration Data

When conducting tests to obtain GC calibration data, the following information should be recorded.

- a) Column - description and serial number as applicable.
- b) Temperature - column temperature, normally room ambient.
- c) Chart speed - distance/unit time.
- d) Carrier flow rate - hydrogen flow rate through the column (cm³/min).
- e) Sample concentration - ppm for each compound.
- f) Sample volume - OVA by serial number or typically 0.25 cm for standard value.
- g) Recorder scaling - ppm per unit deflection.
- h) Range - range of OVA being used, i.e. X1, X10, X100.
- i) OVA serial number.

To obtain a calibration point, inject a known concentration sample into the GC system and record the resulting chromatogram peak. The retention time for the peak may be scaled from the record or timed with a stop watch. The peak height may be scaled from the record or the OVA readout meter may be observed during the elution of the peak. Figure 10B presents the format of a chart which may be used to record calibration data. Experience has indicated that the peak height response of a compound is linear within the concentration range of 0 to 160 ppm. Therefore, a single calibration point, preferable around the concentration of concern, is normally all that is required to plot peak height response in ppm as a function of compound concentration. Data for other compounds on the same column may also be plotted along with their associated retention times, percent relative response in the total organic Survey Mode, TLV, etc. It is recommended that copies of the actual chromatograms be kept with the charts for observing the peak shapes, peak interferences, etc. It should be noted that a chromatogram can be utilized like a fingerprint for compound identification or peak height and shape comparison. Transparent overlays are an aid in chromatogram analysis.

When temperature variations are anticipated, data should be taken at several points and recorded on the chart as a new curve or as a relative change as a function of temperature as illustrated in Figure 10B.

Preparing and using the calibration chart is very straightforward. As an example, once the elution sequence of a group of compounds is determined, a mixture of 100 ppm of each can be prepared and run on the GC for chart data. The retention time of each compound and the peak height of each can be read directly from the chromatogram and the data put on the chart. If temperature data is to be taken, additional chromatograms may be run with the same sample and the RT and peak height as a function of temperature.

When complex mixtures such as gasoline are analyzed, it may be desirable to keep the record of the backflush peak for future reference and peak area comparison. It is also recommended that the total organic vapor concentration reading on the OVA be recorded for each calibration sample used. This reading is used for arriving at relative response numbers and as a check on sample preparation precision.

Routine Maintenance

a) COLUMN

Any column can be contaminated with compounds having long retention times. This will result in high background readings. This condition can be checked by installing a new column or a blank column (tubing only). If this reduces the background reading, the contaminated column should be baked at 100°C (212°F) for three (3) to four (4) hours in a drying oven while passing nitrogen through the column. Higher temperatures may permanently damage the column packing.

When installing any column, avoid touching the ends, as this may cause contamination. Also, ensure that the fittings are tight to avoid hydrogen leakage.

IMPORTANT: The following simple test may be run to determine whether the GC column is contaminated. While in a clean ambient air background, place the Sample Inject Valve in the "In" (GC Model) position. Observe the background reading on the meter or recorder. After one (1) to two (2) minutes, change the position of the Back-flush Valve and again observe the background reading. If the background reading went down and then started to increase in one to two minutes, the column is probably contaminated and needs to be cleaned. Note that if hydrogen flows into one end of the column for a period of time, the contamination is pushed into the column.

Then when the hydrogen flow is reversed, the exhaust end of the column will be clean until the contamination is again pushed through. Remember that to clean a column the purge gas must be run through the column in one direction until all contamination is removed. **NOTE:** Contaminated columns can be avoided by back-flushing the column after every analysis.

b) CHARCOAL FILTER ASSEMBLY

After repeated use, the Charcoal Filter Assembly will become saturated. Periodically, the operator should check the effectiveness of the activated charcoal.

This can easily be done by operating the unit with the Sample Injection Valve "In" and passing the probe near a concentrated sample of the compound being analyzed. The readout should remain nearly steady (should not rise more than 0 to 2 parts per million (ppm)). If rise is more than 2 ppm, replace the old charcoal with new activated charcoal. Care should be taken to completely fill the tube to prevent a path for sample to bypass the charcoal. The life of the charcoal depends on the time (length) of exposure and the concentration level during that exposure. When changing charcoal, be sure that any fine charcoal dust is removed from the assembly.

Another test of the charcoal filter is to note the background reading with the Sample Inject Valve "out" and then note the reading with the valve "In". The level should never be higher when the valve is in the "In" position and the charcoal filter is in the air line. If the reading with the valve in the "In" position is higher, the charcoal filter is probably contaminated and acting like a contamination emitter.

Trouble Shooting

Table 2 presents recommended field trouble shooting procedures which are associated with the GC system. These procedures are in addition to those found in the basic OVA section of the manual.

TABLE 2

PROBLEM	TROUBLE SHOOTING PROCEDURES	REMEDY
1) Low sample flow rate on flow indicator.	<p>a) Check Teflon tubing on valve assembly for kinks, etc.</p> <p>b) Check flow rate with valve in down position.</p>	<p>Straighten or replace teflon tubing.</p> <p>Check for over restriction of charcoal filter.</p>
2) Hydrogen flame will not light.	<p>a) Check column connections on top of unit to make sure they are tight.</p> <p>b) Check column for sharp bends or kinks. (Hydrogen flows through this column at all times and a sharp bend will compact packing too tightly for proper hydrogen flow).</p> <p>c) Check charcoal filter fittings to make sure they are tight.</p> <p>d) Check hydrogen flow rate from the column.</p> <p>e) Check that the Inject and Back-flush Valves are both completely in or out. A partially activated valve will block the hydrogen and air flow paths.</p> <p>f) If a new column was installed prior to problem identification, check for proper hydrogen flow rate through the column (should be approximately 12 cm /min).</p>	<p>Tighten fittings.</p> <p>Replace column.</p> <p>Tighten fittings.</p> <p>Adjust hydrogen pressure to obtain 12 cm /min flow rate.</p> <p>Ensure both valves are either completely in or out.</p> <p>Increase hydrogen pressure to obtain proper hydrogen flow rate or if column is excessively restrictive, replace or repeat the column.</p>
3) Ambient background reading in clean environment is too high.	<p>a) Check for contamination in charcoal filter assembly. This can be detected if ambient reading increases when going in to the chromatographic mode.</p> <p>b) Check for contamination in column.</p> <p>c) Check for contamination in column valve assembly.</p>	<p>Replace activated charcoal in charcoal filter assembly.</p> <p>Replace or clean column.</p> <p>Remove valve stems and wipe with clean lint-free cloth. Heat valve assembly during operation to vaporize and remove contaminants.</p>
4) Flame-out when operating either valve.	<p>a) Ensure valves are being operated with a quick, positive motion.</p>	<p>Operate valve with a positive motion.</p>

TABLE 2

PROBLEM	TROUBLE SHOOTING PROCEDURE	REMEDY
	b) Either hydrogen or air may be leaking around one or more of the valve quad rings. Assess by tests and "O" ring inspection.	Remove stems and lightly coat with silicone grease, only on contact surface of the "O" ring. Wipe off excess (do not remove quad rings).
	c) Damaged or worn quad rings causing leak.	Replace quad rings and grease as above.
5) Excessive peak tailing	a) Change or clean GC: see if problem disappears.	Ensure columns are clean prior to use. If one of the same type of column tails are worse than others, reconnect the column or discard.
	b) Inspect GC valves for excessive silicone grease or contamination.	Excessive lubricant or foreign matter in the valve assembly can cause excessive tailing. Clean valve assemblies and lightly relubricate as required. Lubricant should be put only on the outside contact surface of the "O" ring. Do not get grease into the "O" ring grooves.

Recommended Spares

The following spare parts and supplies are recommended to support the GC system and recorder. These are an addition to the spare parts list for the basic OVA described in the "OVA MAINTENANCE" section.

ITEM DESCRIPTION	PART NO.
1) Quad Rings	510496-1 (10/pkg.)
2) Tubing, .148 in ID .020 wall	12942
3) Tubing, Teflon .120 in ID .030 wall	12941
4) Activated Charcoal	CSC-004
5) "O" Ring for Charcoal Scrubber	U0118CE
6) Chart Paper (linear)	CSC-008 (6/rls/pkg)

ACCESSORIES

Recorder Accessory

A portable Strip Chart Recorder is available for use with the OVA (reference Figure 11). The recorder is powered from the OVA battery pack and the output can be scaled to match the OVA readout meter, thereby providing a permanent record for subsequent analysis or reference. P/N 510445-4 is FM certified intrinsically safe. P/N 510445-6 is BASEEPA certified.

The recorder can be used with the OVA to provide a long term monitoring profile of total hydrocarbon or can be used with the Gas Chromatograph Option to provide a chromatogram.

Features

The recorder prints dry (no ink) on pressure sensitive chart paper. The recorder is equipped with two gain ranges and an electronic zero adjustment. The HIGH gain position is normally used to provide a means of scale expansion.

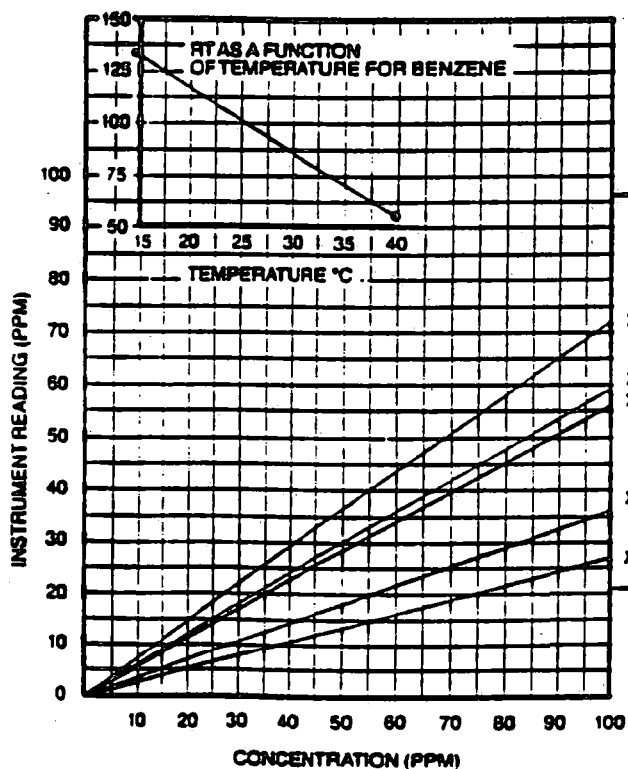
Controls and Connections

Described below are the functions of recorder controls and connectors.

- 1) **HIGH-LOW Switch** - This switch, located on the right hand side of the recorder, provides 2 ranges. The LOW range is set for the same full scale reading as the OVA readout meter. The HIGH range can be set to give an increased sensitivity to the recorder without affecting the OVA calibration.
- 2) **ZERO ADJUST Knob** - This potentiometer, located on the right hand side of the recorder, permits "nulling" of the background reading on the recorder without affecting the calibration of the OVA displayed on the OVA readout. In the full clockwise position, the recorder will display the same reading as the OVA meter. Counterclockwise rotation will reduce the reading on the recorder.

- 3) **POWER CONNECTOR** - This 126 series, 5 pin connector provides power and signal to the recorder, as follows:

PIN	FUNCTION
B	Input Signal
E	pos. 12VDC input
H	Ground



Column G-18 Chromatograph OVA-128
Temperature 25°C Carrier Flow 1.7 mL/sec.
Injection Volume 2.5 mL Type mix

X	Compound	R.R (%)	RT (sec)	TLV (ppm)
X4	Heptane	80	471	400
X2	Pentane	100	90	1000
X2	Hexane	90	190	100
X2	Benzene	150	291	1
X3	Toluene	120	762	200

- NOTE:
1. Concentration used for test is 100 ppm or as indicated.
 2. X = Concentration multiplier

FIGURE 10A
CALIBRATION CHART

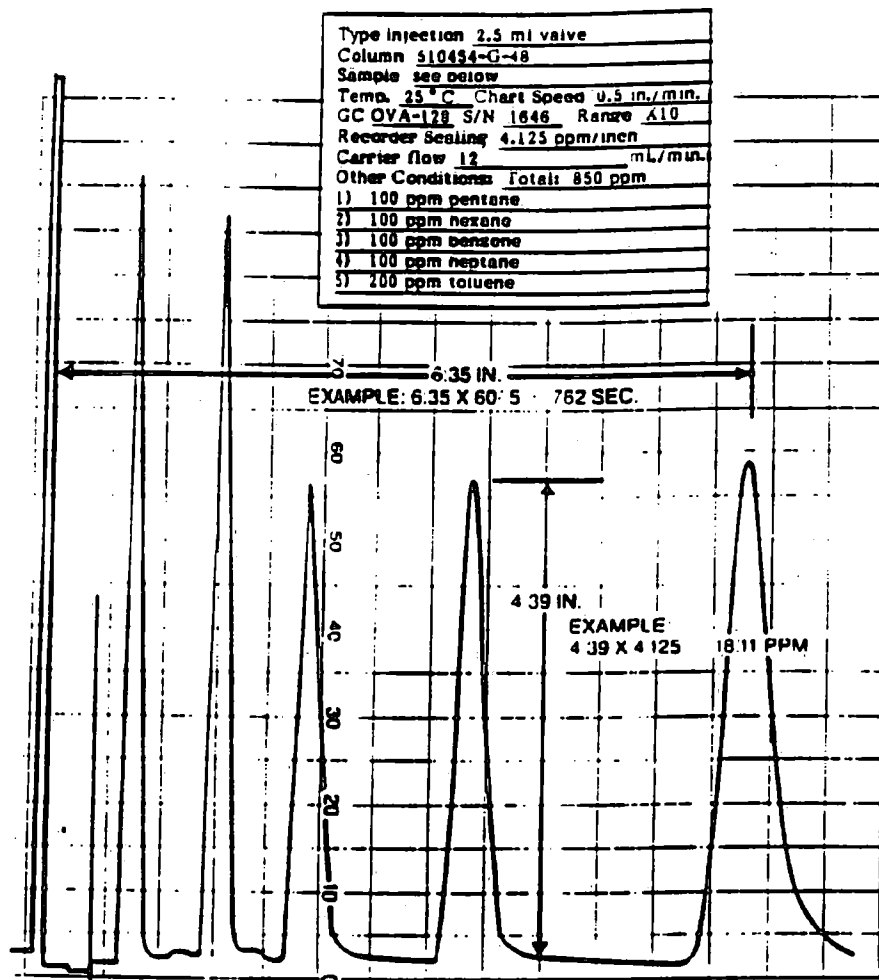


FIGURE 108
CHROMATOGRAM

Calibration

Electronic and mechanical adjustments, other than the operational adjustments on the side panel, are provided to calibrate and align the recorder. (See Figure 11).

MECHANICAL ZERO ADJUSTMENT

- A) Snap out the front panel nameplate using a small blade screwdriver in the left hand slot for access to mechanical zero adjust screw, place HIGH-LOW Switch in OFF position.

- B) Unscrew knurled fastener at top of front panel to open recorder. Pull down plastic chassis latch on right side to release sticker bar tension on paper and adjust mechanical zero as required. Replace nameplate, chassis latch and resecure front panel.

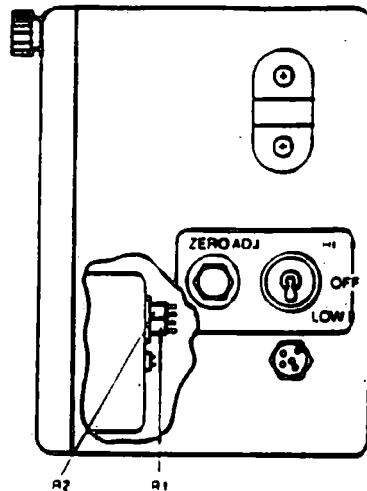


FIGURE 11
RECORDER CONTROLS AND ADJUSTMENTS

GAIN ADJUSTMENT

Separate adjustments are provided for the HIGH and LOW ranges on the recorder. (Refer to Figure 11 for location).

- Connect recorder to OVA and adjust OVA for full scale reading on readout (about 5 VDC).
- Loosen knurled fastener on upper left of the front panel and pull front panel down.
- Place HIGH-LOW Switch in LOW and adjust R1 until recorder prints full scale.
- Place HIGH-LOW Switch in HIGH and adjust OVA to read the desired full scale with front panel CALIBRATE ADJUST Knob, typically half scale on the readout. Adjust R2 until recorder reads full scale. NOTE: Full scale adjustment of the recorder for 1/2 scale on the OVA gives a gain increase of two (2) in the height of the peak on the chromatograms. This is the factory set point for the HIGH gain range; however, other points can be set as desired with a gain of three being the maximum obtainable without amplifier loading.

Maintenance and Routine Operations

Refer to the manufacturer's (Gulton) manual on the recorder which is enclosed with each recorder when shipped.

Changing Chart Speeds

The recorder is equipped with a 16 RPM motor which gives a writing speed of four (4) strikes per second. The chart advance speed is determined by the gear train assembly number used. The inches per hour for each gear train is given in the table on page 9 of the Gulton recorder manual. Refer to the bottom line of the chart adjacent to drive motor 16 and note for example that a number 1 gear train has a chart speed of 8"/hour.

- To change the paper speed, open the recorder, remove gear box spring (on left side), move gear box in direction of arrow on its case and lift out from top. Do not force out from bottom. Insert new gear, bottom first, slide into position against arrow direction. Replace gear box spring.

Activated Charcoal Filter Accessory

The Activated Charcoal Filter Assembly is an accessory which can be installed on the OVA Readout Assembly or attached at the end of the telescoping probe. The filter is typically filled with activated charcoal which acts as an absorbent and effectively filters out organic vapors other than methane or ethane.

A screw cap on the probe end is removed for refilling the filter with activated charcoal or other filtering media.

Applications of the filter include:

- Obtaining a clean air sample for zero baseline check and adjustment.
- Running "blank" chromatograms to assess instrument contamination.
- Rapid screening of methane and non-methane organic vapors.
- Selective screening for natural gas surveys.
- As a moisture filter when filled with a desiccant such as silica gel.

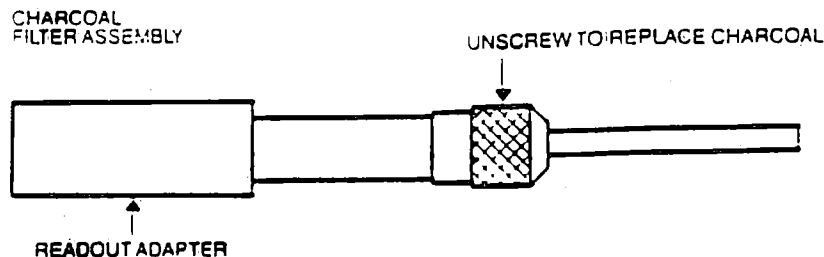


FIGURE 12
ACTIVATED CHARCOAL FILTER ASSEMBLY

A press fit adapter on the back of the filter assembly is removed when installing the unit on the telescoping probe. When replacing the cap end after refilling, one wrap of $\frac{1}{4}$ inch teflon tape should be used to seal the threads.

The life of the filter will depend on the time in use and the concentrations of the compounds being filtered. Under typical industrial air monitoring conditions, the filter will last for many days of continuous sampling. See Figure 12.

Sample Dilutor Accessory

An adjustable sample dilutor assembly, P/N 511743-1 is an accessory. The dilutor is supplied with a 10:1 dilution orifice as standard. Orifices for 25:1, P/N 511770-2, and 50:1, P/N 511770-3, dilution are also available.

In operation, the dilutor is attached to the end of the telescoping probe or connected by external tubing to the input fitting of the OVA side pack. Dilution of the air being monitored is accomplished by stream splitting through the use of a needle valve on the sample input. An activated charcoal scrubber is inserted in the main air supply line to the OVA and scrubs the air of organic vapors. It also creates a slight vacuum at its output side of the scrubber and the vacuum at this point draws the sample air through the needle valve where it mixes with the main air supply going to the OVA detector.

The dilution valve provides a means of sampling vapor levels above the lower explosive level (LEL) and in oxygen deficient atmospheres. These conditions can occur in normal leak or source survey as the operator gets close to the leak or vapor source or in monitoring various manufacturing or material handling processes. Approximately 14% oxygen is required to sustain operation of the FID in the OVA.

Setting Dilution Rate

Prepare a sample in a bag at a high level, typically 1,000 to 5,000 ppm. Any suitable gas can be used, such as butane from a cigarette lighter; however, a compound similar to those to be measured provides greater accuracy. The actual concentration of the gas does not have to be known, since the dilution rate is simply a relative level.

Obtain an OVA reading on the vapor sample with the dilution valve removed. Then install the valve, loosen the jam nut and turn the needle valve until the meter reading corresponds to the original reading divided by the dilution factor desired. Retighten the jam nut.

It should be noted that when the dilution valve is used for natural gas leak survey and pinpointing, the charcoal filter will not remove the methane from the dilution air supply. Care should be taken so that natural gas is not allowed to enter the main air inlet. (See Figure 13.)

OVA Septum Adapter Accessory

A Septum Adapter, P/N 510645-1, is available for direct on-line sample injection to the GC column inlet. The Septum Adapter mounts directly on the OVA front panel and sample injections from .025 to 2.5 cm may be made using a gas tight syringe.

This provides a range of sensitivity of approximately 10% to 1000% of the OVA standard valve, which has a sample loop volume of approximately 0.25 cm³. Syringe injection can cause flame-out, however, the OVA may be reignited after the injection is made. The air in the sample must elute from the column before reignition. The time for the air peak to elute is a function of the column length and the volume of the sample injected. For example, a 1 cm sample into a 12' column will require approximately 5 seconds; and, a 2.5 cm sample into a 48' column will require approximately 20 seconds.

The Septum Adapter also provides a means whereby samples from oxygen deficient atmospheres or process streams can be injected directly into the chromatograph. Headspace analysis may also be accomplished using the Septum Adapter and a syringe.

OVA Portable Isothermal Pack (PIP) Accessory

A column can separate an exceptionally wide variety of components if the separations are made at different temperature ranges. In addition, peak heights and retention times can vary with column temperature. The PIP option was developed to control column temperature, without affecting the analyzer's intrinsic safety specifications and without compromising the analyzer's portability.

When the Septum Adapter is installed on the OVA, the normal GC sample valve may still be used alternatively with the syringe injection. In addition to variable sample size and sensitivity, syringe injections will normally provide greater symmetry and reduce tailing of chromatogram peaks as compared with the standard valve injection.

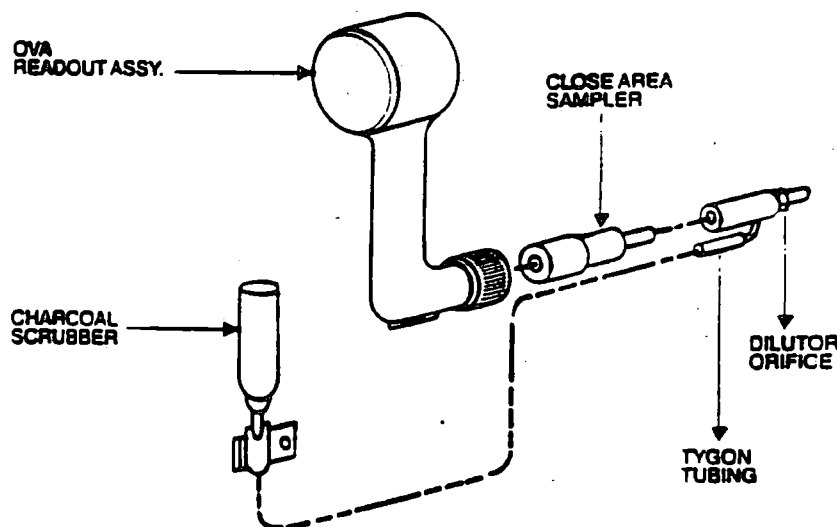


FIGURE 13
OVA SAMPLE DILUTOR

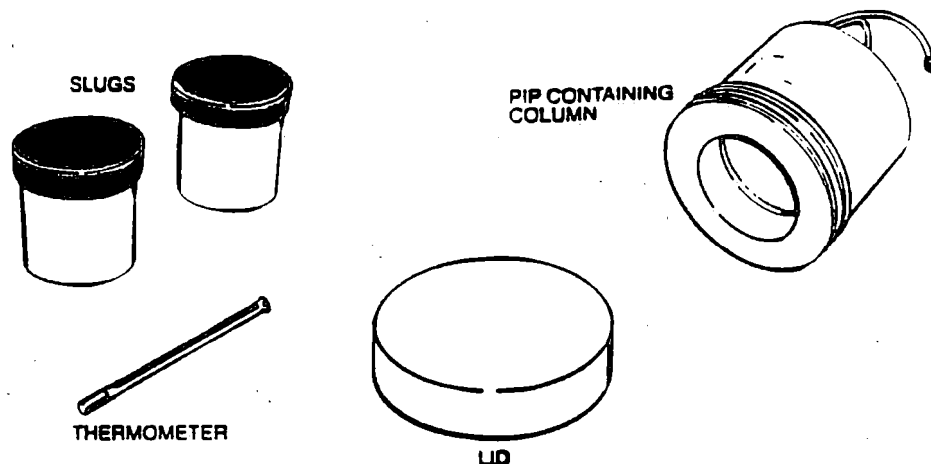


FIGURE 14
PORTABLE ISOTHERMAL PACK

PIP Components & Spare Parts

511800-1	PIP Kit
511805-1	PIP Assembly (specify column length and packing material)
511810-1	40°C Slug (phase-change material)
511830-1	Seeder for 40°C Slug
511815-1	Aluminum Slug
511820-1	Empty Bottles (package of six)
511829-1	Insulating Cover
511826-1	Thermometer

PIP columns can be prepared with any standard column packing material. A temperature control slug is inserted into the PIP slug cavity which has exterior foam insulation. For field operation in extreme ambient temperatures, an additional sheepskin jacket can be installed. The period of temperature control depends upon the temperature difference between ambient and the slug. For a 0°C ice pack and ambient temperature of 27°C, a control period of approximately 10 hours is typical. Additional information on the PIP system will be found in Foxboro document T1611-105.

CENTURY is a trademark of The Foxboro Company.

Teflon is a trademark of E.I. duPont de Nemours and Company.

Snoop is a trademark of The Nupro Company.

Kel-F is a trademark of M.W. Kellogg Company.

Chromosorb is a trademark of Johns-Manville.

Carbowax is a trademark of Union Carbide Corporation.

Poropak is a trademark of Waters Associates.

Porasil is a trademark of Waters Associates.

812

SERVICE PROCEDURES
ORGANIC VAPOR ANALYZER

FEBRUARY 10, 1982

REGULAR MAINTENANCE
ORGANIC VAPOR ANALYZER

<u>PROCEDURE</u>	<u>FREQUENCY</u>
○ CHECK PARTICLE FILTERS	DAILY
○ CHECK QUAD RINGS	WEEKLY
○ CLEAN BURNER CHAMBER	WEEKLY
○ CHECK CALIBRATION	DAILY
⊙ CHECK PUMPING SYSTEM	DAILY

INDICATORS OF MALFUNCTION
ORGANIC VAPOR ANALYZER

INDICATION

POSSIBLE CAUSES

- HIGH BACKGROUND READING
(MORE THAN 10PPM)

1. CONTAMINATED HYDROGEN
2. CONTAMINATED SAMPLE LINE

- CONTINUAL FLAMEOUT

1. HYDROGEN LEAK
2. DIRTY BURNER CHAMBER
3. DIRTY AIR FILTERS

- LOW AIR FLOW

1. DIRTY AIR FILTER
2. PUMP MALFUNCTION
3. LINE OBSTRUCTION

- FLAME WILL NOT LIGHT

1. LOW BATTERY
2. IGNITOR BROKEN
3. HYDROGEN LEAK
4. DIRTY BURNER CHAMBER
5. AIR FLOW RESTRICTED

- NO POWER TO PUMP

1. LOW BATTERY
2. SHORT CIRCUIT

- HYDROGEN LEAK
(INSTRUMENT NOT IN USE)

1. LEAK IN REGULATOR
2. LEAK IN VALVES

PRECAUTIONS FOR BEST PERFORMANCE
ORGANIC VAPOR ANALYZER

- KEEP BATTERY ON CHARGER WHEN NOT IN USE
- RECHARGE BATTERY AS SOON AS POSSIBLE AFTER USE
- AVOID DROPPING METER/PROBE ASSEMBLY
- AVOID INTAKE OF HIGH BOILING VAPORS
- BACKFLUSH COLUMN AFTER EACH CHROMATOGRAM
- DO NOT OVERTIGHTEN VALVES
- USE HYDROGEN WHICH CONTAINS LESS THAN 2PPM HYDROCARBONS

OVA - 128 CALIBRATION

1. REMOVE INSTRUMENT FROM CASE.
2. TURN ON ELECTRONICS AND ZERO INSTRUMENT ON X-10 SCALE. GAS SELECT DIAL TO 300.
3. TURN ON PUMP AND HYDROGEN. IGNITE FLAME. GO TO SURVEY MODE.
4. INTRODUCE A METHANE STANDARD NEAR 100PPM.
5. ADJUST R-32 TRIMPOT ON CIRCUIT BOARD TO MAKE METER READ TO STANDARD.
6. TURN OFF HYDROGEN FLAME AND ADJUST METER NEEDLE TO READ 4PPM.
7. SWITCH TO X1 SCALE AND ADJUST R-31 TRIMPOT TO MAKE METER READ 4PPM.
8. RETURN TO X10 SCALE AND ADJUST METER NEEDLE TO 40PPM.
9. SWITCH TO X100 SCALE AND ADJUST R-33 TRIMPOT TO MAKE METER READ 40PPM.

PUMP SYSTEM CHECK

1. WITH PUMP ON, HOLD UNIT UPRIGHT AND OBSERVE FLOW GAUGE.
2. BALL LEVEL SIGNIFICANTLY BELOW A READING OF 2 IS LOW FLOW.
3. CLEAN OR REPLACE PARTICLE FILTERS.
4. RE-ASSEMBLE AND RETEST FLOW.
5. IF FLOW STILL LOW, REPLACE PUMP DIAPHRAGM AND VALVES.
6. IF FLOW NORMAL, PLUG AIR INTAKE. PUMP SHOULD SLOW AND STOP.
7. IF NO NOTICABLE CHANGE IN PUMP, TIGHTEN FITTINGS AND RETEST.
8. IF STILL NO CHANGE, REPLACE PUMP DIAPHRAGM AND VALVES.

HYDROGEN VALVE PACKING REMOVAL

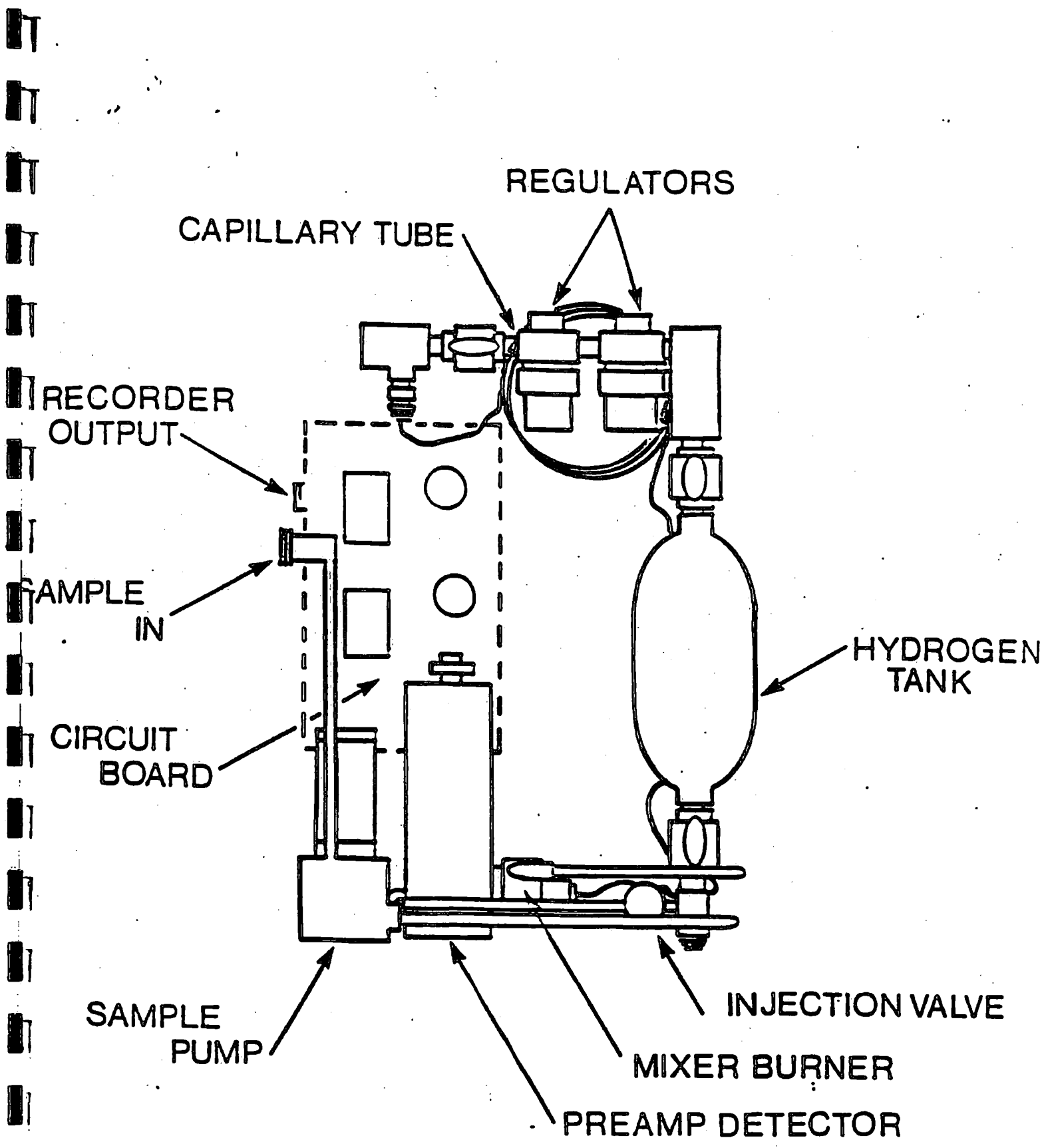
1. REMOVE INSTRUMENT FROM CASE.
2. REMOVE VALVE KNOBS.
3. REMOVE CAPILLARY TUBE.
4. REMOVE FILLER CAP AND FITTING.
5. REMOVE THREE NUTS FROM VALVES AND PULL TANK ASSEMBLY FROM OVA.
6. UNSCREW PACKING RETAINER NUT FROM VALVE TO BE SERVICED.
7. TURN VALVE SHAFT COUNTER-CLOCKWISE TO REMOVE SHAFT AND PACKING. REPLACE PARTS AS REQUIRED.
8. RE-ASSEMBLE VALVE AND REPLACE TANK ASSEMBLY IN OVA.

QUAD RING SERVICE

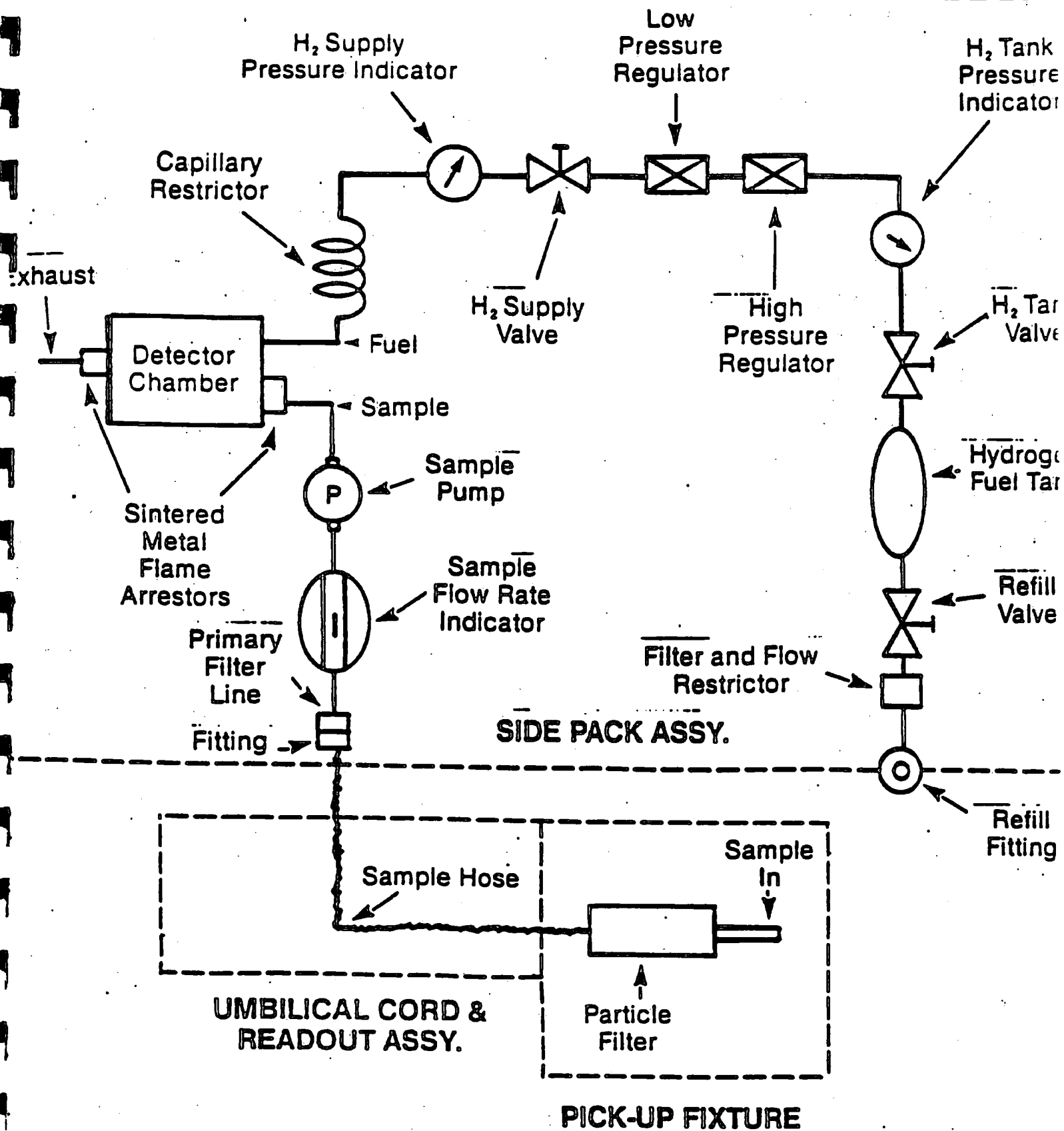
1. REMOVE OVA FROM CASE.
2. REMOVE CLIP RING FROM BOTTOM OF VALVE.
3. UNSCREW NUT FROM TOP OF VALVE.
4. GENTLY PULL VALVE SHAFT UPWARD AND FREE OF HOUSING.
5. OBSERVE RINGS FOR SIGNS OF DAMAGE - REPLACE AS NECESSARY.
6. LIGHTLY GREASE RINGS.
7. RE-ASSEMBLE VALVE - DO NOT PINCH RINGS DURING SHAFT INSERTION.

BURNER CHAMBER CLEANING

1. REMOVE PLASTIC EXHAUST PORT COVER.
2. UNSCREW EXHAUST PORT.
3. USE WIRE BRUSH TO CLEAN BURNER TIP AND ELECTRODE. USE WOOD STICK TO CLEAN TEFLON. AVOID TOUCHING IGNITOR.
4. BRUSH INSIDE OF EXHAUST PORT.
5. BLOW OUT CHAMBER WITH A GENTLE AIR FLOW.
6. RE-ASSEMBLE AND TEST UNIT.



ORGANIC VAPOR ANALYZER SCHEMATIC



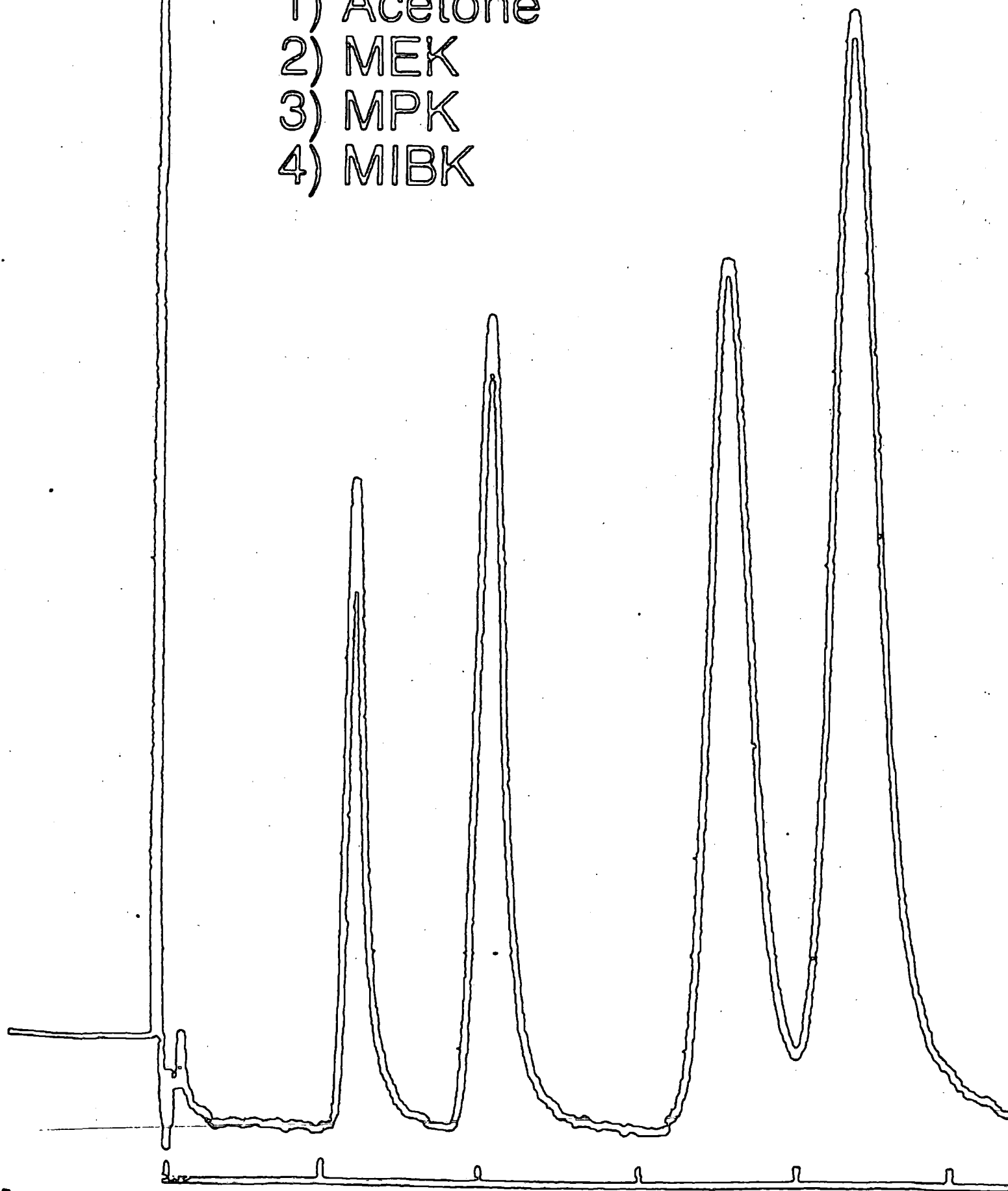
FLOW DIAGRAM GAS HANDLING SYSTEM

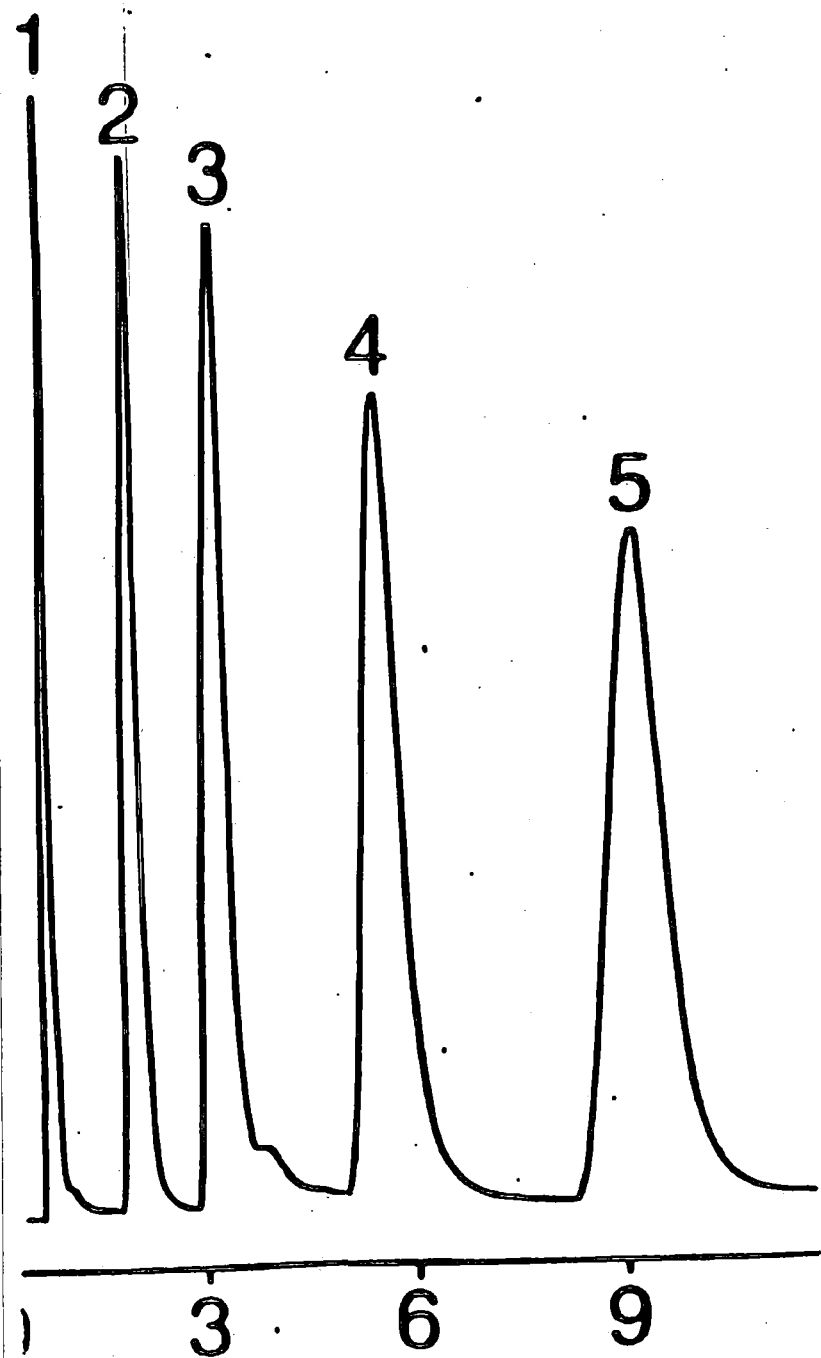
OVA-128 SPARES

<u>ITEM</u>	<u>QUANTITY</u>
Ignitor P/N 510461-1	2
Temp Valve P/N 510067-3	1 pkg of 10
Temp Diaphragm P/N 510063-1	1
Filter Cup P/N 510318-1	1 pkg of 5
Exer/Burner Assembly P/N 510513-1	1
Teflon Wafer P/N 510160-1	1 pkg of 10
Pass Washer P/N 510-160-2	1 pkg of 10
Exhaust Port Assembly P/N 510530-1	1
Battery Pack P/N 510542-1	2
Sample Line Assembly P/N 510316-1	1
Particle Filter P/N 510116-1	1
Gasket Rings P/N 510496-1	1 pkg of 10
Teflon Tubing 0.143" ID x .020 Wall P/N 12942	1 ft
Teflon Tubing 0.120" ID x .030 Wall P/N 12941	1 ft
Activated Charcoal GI	1 lb
20" Ring P/N 2-15	2
Chart Paper Type WA P/N CSC-008	1 pkg of 6 rolls

.....
Ambient Temperature

- 1) Acetone
- 2) MEK
- 3) MPK
- 4) MIBK





G-24 Column

- 1) Methylene Chloride
- 2) 1, 1, 1 Trichloroethylene
- 3) Trichloroethylene
- 4) 1, 1, 2 Trichloroethylene
- 5) Tetrachloroethylene

CENTURY DILUTOR KIT

Correction to Operator Instructions MI 611-102

The parts list on the front page under INTRODUCTION has been changed.
The current parts list is shown below.

<u>ITEM</u>	<u>PART</u>	<u>QUANTITY</u>
Dilutor Fitting	511765-1	1
10:1 Dilutor Orifice	511770-1	1
Charcoal Scrubber	510855-1	1
1 cm Spacer	511750-1	1
Adjusting Clamp	XPOC2LS	1
4 ft. Tygon Tubing	XPOC13W	1
Disposable Charcoal Filters (Pkg. of 5)	511750-1	1
O-Ring	G0123MZ	10
Flexible 1 cm Spacer	511775-1	1

9/85

FOXBORO

User's Manual

MICROTIP™

Photovac International
Incorporated

741 Port Avenue
Huntington, New York 11743
USA
Telephone: 616-381-5809
Fax: 616-649-0031



Photovac Incorporated

108 Danvers Avenue
Thornhill, Ontario
Canada L3T 1L8
Telephone: 416-631-8225
Fax: 416-631-3831
Telex: (USA) 7600242
Telex: (CANADA) PHOTO

Table of Contents

Chapter**Page**

1.	Introduction	1
	1.1 Unpacking	
	1.2 Recharging the Battery	
2.	Operation	3
	2.1 Overview	
	2.2 Tutorial Session	
	2.3 DISPLAY	
	2.4 LIGHT	
	2.5 BATT	
	2.6 MAX	
	2.7 CLEAR	
	2.8 EVENT	
	2.9 EXIT	
	2.10 SETUP	
	2.11 AUDIO	
	2.12 ALARM	
	2.13 PLAY	
	2.14 CAL	
	2.15 PRINT	
	2.16 GRAPH	
3.	Accessories and Other Devices	15
	3.1 Computer	
	3.2 Chart Recorder	
	3.3 Headset	
	3.4 Sample Bag	
	3.5 Three-meter (9.8ft) Sample Line	
	3.6 Carrying Strap	
4.	Routine Maintenance	17
	4.1 Battery Charging	
	4.2 Lamp Window Cleaning	
	4.3 Replacing the Detector UV Lamp	
	4.4 Replacing the Filter Cartridge	
	4.5 Replacing the Pump	
5.	Troubleshooting	21
	5.1 If MicroTIP Draws in Liquid	
	5.2 Instrument Status and Fault Displays	

Chapter**Page**

6.	Technical Description	24
	6.1 Overview	
	6.2 Photoionization Detector	
	6.3 Calibration and Recording	
7.	Specifications	28
8.	Warranty	29

Figure

1.	MicroTIP Layout	1
2.	Normal Display	3
3.	Printed Output	14
4.	Graphed Output	15
5.	Control Housing Showing Pump	19
6.	Block Diagram	24

Table

1.	Tutor Displays	4
2.	Instrument Status	22
3.	Fault Analysis	22

WARNING: THIS EQUIPMENT GENERATES, USES AND CAN RADIATE RADIO FREQUENCY ENERGY AND IF NOT INSTALLED AND USED IN ACCORDANCE WITH THE INSTRUCTION MANUAL, MAY CAUSE INTERFERENCE TO RADIO COMMUNICATIONS. IT HAS BEEN TESTED AND FOUND TO COMPLY WITH THE LIMITS FOR DOC STANDARD C108.8 AND FOR A CLASS A COMPUTING DEVICE PURSUANT TO SUBPART J OF PART 15 OF FCC RULES, WHICH ARE DESIGNED TO PROVIDE REASONABLE PROTECTION AGAINST SUCH INTERFERENCE WHEN OPERATED IN A COMMERCIAL ENVIRONMENT. OPERATION OF THIS EQUIPMENT IN A RESIDENTIAL AREA IS LIKELY TO CAUSE INTERFERENCE IN WHICH CASE THE USER AT HIS OWN EXPENSE WILL BE REQUIRED TO TAKE WHATEVER MEASURES MAY BE REQUIRED TO CORRECT THE INTERFERENCE.

Chapter 1 Introduction

1.1 UNPACKING

Included with the instrument you will find the following standard items:

- User's Manual
- 120/230 Volt Battery Charger
- 17 cm Sample Probe
- 5 Spare Filter Cartridges
- Shoulder Strap

Remove MicroTIP and accessories from the shipping box and examine them for any physical damage. Inform Photovac immediately if MicroTIP or the accessories are damaged.

1.2 RECHARGING THE BATTERY

Before beginning operation of MicroTIP, the battery will require charging.

1. Ensure MicroTIP is off by pressing the front of the power switch. See Figure 1.
2. Set the voltage selector switch on the bottom of the battery charger to the appropriate AC line voltage.
3. Press the release button on the bottom of MicroTIP and remove the battery pack by sliding it backwards. See Figure 1.

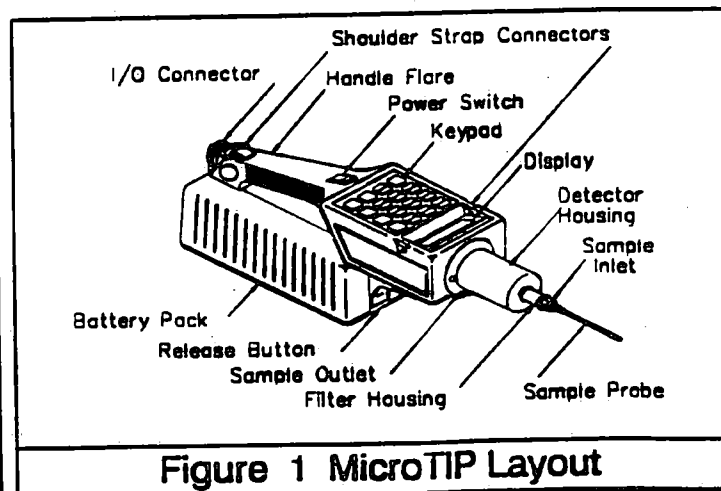


Figure 1 MicroTIP Layout

4. Plug the charger into the battery pack and then into an AC outlet and allow the battery pack to charge for at least 8 hours.
5. After charging, remove the charger, first from the wall outlet, then from the battery pack and slide the battery pack back onto MicroTIP.

The instrument is now fully charged and ready for use.

Chapter 2 Operation

2.1 OVERVIEW

MicroTIP measures the concentration of airborne ionizable gases and vapors and automatically displays and records these concentrations.

Turn the instrument on by pressing the back of the power switch. The pump will start and the message "Warming up now, please wait" is displayed. Within three minutes the following information will appear on the display: Instrument status, detected concentration, Event number, time, and date. Figure 2 shows this normal display.

Warming up now,
please wait...

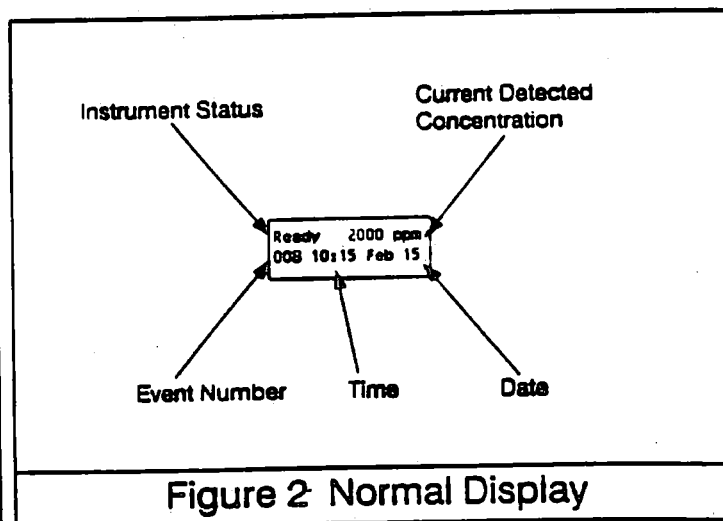


Figure 2 Normal Display

MicroTIP operates automatically. The user reads concentrations directly from MicroTIP's display. The display updates itself each half second.

The Minimum, Maximum, and Average concentrations measured in each 15-second period are automatically recorded in MicroTIP's datalogging memory. MicroTIP's memory holds the last 12.0 hours of concentration data measured.

Concentration data can be played back from memory on MicroTIP's display or sent to a printer or computer in either tabular or graphical form. Data are recorded by date, time, and by a user-entered event number. Data are played back by the user specifying a start and a stop event number.

The keypad is used to set up and calibrate MicroTIP, and allows the user to manipulate the concentrations measured and recorded by MicroTIP in various ways. MicroTIP has 16 clearly-labelled keys for direct numeric entry and for using MicroTIP's functions.

All information entered from the keypad and stored in MicroTIP's datalogging memory is retained when MicroTIP is switched off. The clock and calendar continue to operate and do not need to be reset the next time MicroTIP is used.

2.2 TUTORIAL SESSION

To assist the user in learning the key functions, MicroTIP has a built-in tutorial session which displays a two-line description of the function of each key. Pressing MicroTIP's TUTOR key begins a tutorial session and pressing the EXIT key twice ends the session. While in the tutorial session keypresses have no effect on MicroTIP's operation.

Press the TUTOR key and begin a tutorial session. Press each key and read the display. The tutorial display for each key is given in the following table:



BATT	Shows battery V. normally 9-16V	ALARM	Shows set-point for conc alarm
DISPLAY	Displays conc as graph or numeral	MAX	Displays highest conc measured
LIGHT	Switches display light hi/lo/off	SETUP	Sets date time & options for keys
AUDIO	Selects alarm or tone or no audio	EVENT	Puts event mark into recorder
PRINT	Prints recorded data on one page	TUTOR	Press a key then read explanation
GRAPH	Graphs recorded data on one page	CLEAR	Erases the last number pressed
PLAY	Replays recorded data on display	EXIT	Cancels key with no more changes
CAL	Calibrates with zero & span gas	ENTER	Confirms display then continues

Table 1 Tutor Displays

Press the EXIT key twice to end the session.

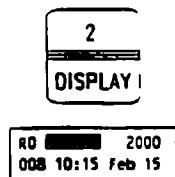
In operation, all MicroTIP's function keys work in the same way.

If there are no options to the function then the key acts immediately.

If there are options, then the display will indicate these. The currently selected option is displayed on the lower line. The user is prompted to display the other options by pressing the up arrow or down arrow keys. Pressing ENTER confirms that the displayed option is correct. If the function requires numeric input then the current value is displayed on the lower line. The user can change it on the display by pressing the numeric keys. Pressing ENTER confirms that the displayed value is correct.

Some functions have multiple steps for options and/or numeric inputs. These are arranged so that the most frequently changed inputs are requested first. Once the desired changes have been made the user can bypass the rest of the steps by pressing EXIT.

Each key function is described in more detail in the following sections. Leave MicroTIP on and try each key in turn.



Battery level, V
12.3

2.3 DISPLAY

If a numerical display is shown, pressing DISPLAY will change it to a bar graph. If the bar graph is shown, pressing DISPLAY changes it to a numerical display. The bar graph range is selected with the SETUP key.

2.4 LIGHT

Backlighting can be one of two intensities. The brighter lighting consumes more power and is recommended for use only in very dark locations. Pressing the LIGHT key switches the backlight on to high intensity, pressing it again decreases the intensity and pressing it once more turns the backlighting off.

2.5 BATT

Pressing the BATT key displays the current battery level. The battery voltage will be shown for 15 seconds and then the display reverts to normal. The normal operating voltage range is 9 to 16 volts. When LoBat is displayed there are approximately 10 minutes of operation

BATTERY PACK
CRITICALLY LOW



0
MAX

Max 112 ppm
026 10:12 Feb 15

Max cleared
026 10:12 Feb 15

CLEAR

EVENT
↑

Ready 500 ppm
255 10:28 Feb 15

Ready 500 ppm
000 10:28 Feb 15

left. The battery pack must be replaced by a fully charged pack and the discharged pack should be recharged. See Section 1.2.

If operation is continued with a low battery pack another message will appear indicating the batteries are critically low. MicroTIP will now turn off the detector lamp, the pump and the backlighting (if activated). This reduces deep discharging of the battery pack and possible memory loss.

Note: Leaving MicroTIP for more than three days, without a battery pack will result in loss of recorded data and setup parameters. To avoid loss of data, charge the battery pack for at least 8 hours and replace it.

2.6 MAX

Press the MAX key. The maximum concentration, the Event during which it was encountered, the time and date of the occurrence will be displayed. This is shown for 15 seconds and then the display reverts to normal.

Pressing MAX and then CLEAR will reset the Max register. "Max Cleared" will be displayed with the current date and time. After 15 seconds the display reverts to normal.

Recording of real time data is not interrupted when the MAX key is pressed or when the Max register is cleared.

2.7 CLEAR

CLEAR erases the last numerical entry. If a number is entered in error press CLEAR to erase the entry and re-enter the correct number. CLEAR used in conjunction with the MAX key resets the Max register.

2.8 EVENT

Each press of the EVENT key advances the Event number by one unit on the display. After Event 255, MicroTIP resets the Event counter to zero. Each time the instrument is turned on the Event number is automatically advanced by one unit.

Logged data are played and printed by specifying a start and stop Event number. Press EVENT to help identify a particular sample or sampling location in memory.



Note: MicroTIP only stores the last Event seen in a 15 second period. If the user wishes to assign a specific Event number to a sample, the EVENT key should be pressed only once every 15 seconds. If the Event key is pressed more than once in a 15 second period lower Event numbers will not be stored.

MicroTIP records continuously for a period of 12.0 hours. After this time it begins to overwrite existing data one Event at a time.

For example: 6 Events of 2 hours each are recorded. Event #7 will overwrite event #1 if it is 2 hours or less in length. If Event #7 is greater than 2 hours it will overwrite Event #2 as well. If Event #7 is 3 hours, then Events #3, #4, #5, #6 and #7 are now in the recorder.

If it is necessary to retain a copy of all recorded data, the data should be printed or stored in a computer at least once every 12.0 hours of operation to prevent loss of information when the Events are overwritten.


EXIT

2.9 EXIT

The EXIT key terminates all MicroTIP functions except DISPLAY, LIGHT, and EVENT. The display reverts to normal. Most functions exit automatically if no key is pressed for 15 seconds.

When EXIT is pressed during PRINT or GRAPH, MicroTIP stops sending information to the printer or computer. The printer will continue to print until its buffer is empty.



2.10 SETUP

The SETUP key allows MicroTIP to be set up for a specific application. The current date and time are also set through the Setup command. Press SETUP and step through the functions. Press ENTER to accept the displayed data or enter a numerical value using the keypad and then press ENTER. If no values are entered MicroTIP's display reverts to normal.

To set up the instrument:

1. Press SETUP.
2. The first step sets the range for the bar graph display, the graph output, the audio output, and the 1 volt analog output. Use the up and down arrow keys to select the 20, 200 or 2000 ppm (parts per million) range.

Range 0-7 ppm ↑ ↓
200

Cal memory ? ↑ ↓
1

Hour is ? 0-23
10

Minute is ? 0-59
15

Date is ? 1-31
15

Month is ? 1-12
2

Year is ? 0-99
89

4
AUDIO

Audio output? ↑ ↓
Off

Audio output? ↑ ↓
Audio on Alarm

Audio output? ↑ ↓
Continuous Audio

9
ALARM

Alarm at ? ppm
100.00

3. Next the Cal memory is selected for regular operation or High Sensitivity operation. During High Sensitivity, MicroTIP operates at its highest possible sensitivity. There are 5 Cal Memories which can be used to store 5 sets of calibration information for up to 5 different compounds, for 5 different detector sources or 5 different concentrations of the same compound. Use the up and down arrow keys to select the Cal Memory.
4. Next enter the correct values for the current time. Press ENTER after each value.
5. Enter the numerical values for the day, month and year. Again press ENTER after each selection.

The instrument is now set for operation.

2.11 AUDIO

If a set of headphones is being used with MicroTIP press AUDIO and use the arrow keys to select one of three options for audio output.

To connect the headphones remove the dustcover from the I/O connector and plug in the headphones.

The audio output can be turned off altogether. It can be set so there is audio output during an alarm condition only. The last option is a continuous audio signal with the tone being proportional to the detected concentration.

Use the arrow keys to move through the options to select the desired option, and press ENTER.

The audio volume is controlled by a knob on the headphones.

2.12 ALARM

The ALARM key displays the current alarm level and allows a new alarm level to be entered.

1. Press ALARM.
2. The current alarm is displayed. If this value is correct wait for the display to revert to normal in 15 seconds or press EXIT.

3. If a new value is to be set, enter the value, and press ENTER.

When an alarm condition is detected the instrument status changes to "Alarm" and an audio signal is heard through the headphones (if Audio on Alarm is selected) and remains on until the alarm condition has passed or until it is turned off with the AUDIO key.

7

PLAY

2.13 PLAY

The PLAY key plays back previously recorded data.

If either Audio on Alarm or Continuous Audio is selected the playback audio output (not the real time output) is heard through the headphones. To enable playback audio output, press AUDIO and select the desired output before pressing the PLAY key.

1. Press PLAY. Two options are available. Pressing ENTER begins playback where it was last stopped. Press * to set the playback options.
2. Select the start Event. If the selected Event is not available MicroTIP begins at the closest higher Event.

An Event may not be available if the EVENT key was pressed more than once in 15 seconds, or if the selected Event has been overwritten in the memory by more recent information.
3. Next select which value is to be displayed, either the Minimum, the Average, or the Maximum, with the arrow keys and press ENTER.
4. The data can be played back in either numerical or graphical display by pressing the DISPLAY key.

When MicroTIP is playing back recorded data it is also measuring and recording real time concentrations even though the instrument status is "Play". If, during playback, an instrument status with a priority higher than that of "Play" is encountered in real time operation it will be displayed, but MicroTIP will continue to play back.

The playback speed and direction can be selected using the arrow keys. The speed can be increased or decreased and the information can be viewed in the opposite direction as well. A forward arrow (>) appears in the display if data are being played forward or a backward arrow (<) if the data are being played in reverse.

Press ENTER to freeze the display at any time and use the arrow keys to resume playback. Press EXIT to return to the normal display.

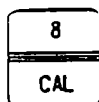
ENTER to Play
* for Options

Start at Event ?
10

Play 100 ppm
001<10:20 Feb 15

Play 100 ppm
001>10:20 Feb 15

The PLAY function provides a speed search to find the desired start and stop Event numbers for printing or graphing.



2.14 CAL

MicroTIP must be calibrated in order to display concentration in units equivalent to ppm. First a supply of Zero Gas, which contains no ionizable gases or vapors, is used to set MicroTIP's zero point. Then, Span Gas, containing a known concentration of an ionizable gas or vapor, is used to set the response factor.

Usually clean outdoor air will be suitable as Zero Gas. If there is any doubt, use a commercial source of Zero Grade Gas and a second sampling bag. A supply of Span Gas of the desired compound and concentration must be obtained for calibration. Observe proper handling techniques for all gases.

Isobutylene at 100 ppm in air is recommended as Span Gas. To calibrate the instrument use the Calibration Kit (Photovac Part No. 390033) as follows:

1. Connect the supplied regulator to the Span Gas cylinder. Hand tighten the fittings.
2. Open the valve on the gas bag by turning the valve stem fully counterclockwise.
3. Attach the gas bag adapter nut to the regulator. Hand tighten the fittings.
4. Turn the regulator knob counterclockwise about half a turn to start the flow of gas.
5. Fill the gas bag about half full and then close the regulator fully clockwise to turn off the flow of gas.
6. Disconnect the bag from the adapter and empty it. Flush the bag a few times with the Span Gas and then fill it.
7. Close the gas bag by turning the valve clockwise.
8. Press SETUP and select the desired Cal Memory with the arrow keys and press ENTER. Press EXIT to leave Setup.
9. Press CAL and expose MicroTIP to Zero Gas. Press ENTER and MicroTIP sets its zero point.
10. MicroTIP then asks for the Span Gas concentration. Enter

Cal memory ? ↑ ↓
1

Connect zero gas
then press ENTER

Span conc ? ppm
100.00

Calibrating now,
please wait....

the known Span Gas concentration and then connect the Span Gas bag adapter to the inlet.

11. Press ENTER and MicroTIP sets its response factor.
12. When MicroTIP's display reverts to normal, MicroTIP is calibrated and ready for use. Remove the Span Gas bag from the inlet.

MicroTIP has 5 Cal Memories and can be calibrated with 5 different span gases if desired. Only one Cal Memory can be used at a time. Each memory stores a different zero point and response factor. To program the Cal Memories:

1. Press SETUP and select the desired Cal Memory (1 to 5) with the arrow keys.
2. Exit from Setup and press the CAL key.
3. Follow the displayed calibration instructions. When the calibration is completed it is automatically stored in the selected Cal Memory.

Whenever the instrument is calibrated, MicroTIP updates the selected Cal Memory. The instrument should be calibrated once a day.

MicroTIP can also be used as a high sensitivity leak detector. When High Sensitivity is selected in Setup, only Zero Gas is required for calibration. MicroTIP does not read directly in ppm but shows a reading proportional to the concentration of ionizable gases and vapors in the sample. During calibration in High Sensitivity MicroTIP does not ask for Span Gas but automatically sets itself to the maximum response factor.

5

PRINT

2.15 PRINT

MicroTIP is compatible with Epson FX-80* type serial dot matrix printers. The printer must be set to 8 data bits and 1 stop bit to communicate with MicroTIP. Refer to the printer user's manual for more information.

To print recorded data:

1. Use the printer cable and suitable adapter (Photovac Part No. 395006) to connect the MicroTIP I/O connector to the printer.
2. Press the PRINT key and then the * key to select the desired setup options.

ENTER to Print
* for Options

Start at Event ?
001

Stop with Event?
024

Baud rate ? ↑ ↓
9600

Parity ? ↑ ↓
None

Printing now,
please wait...

3. MicroTIP will ask for the number of the start and stop Events. Enter the desired values and press ENTER.
4. Enter the baud rate and parity. These values are specific to the type of printer being used. Again, refer to the printer user's manual for more information.

When the setup is correct, ensure the printer is on line and press ENTER. MicroTIP will format the selected data and calculate an averaging interval so that all Events between the selected start and stop Events will fit on one page. The following information is printed:

- a. The number of readings in an interval and the length of the interval are printed at the top of the page.

In Figure 3 there are 14 readings in an interval and the interval is 210 seconds long. MicroTIP always stores one set of readings (Min, Avg and Max) each 15 seconds.
- b. The interval start time.
- c. The lowest Event number in the interval, only if the Event number has changed.
- d. The highest priority status of the interval.
- e. Space for the user to add Notes to the report. Notes could include identification of particular samples or sampling location based on Event numbers.

While the information is being printed, the display shows that printing is in progress. The keypad will not accept commands until the present print job has been completed.

In order to print all information between two Events, the averaging interval should be one reading or 15 seconds. The start and stop Events can be adjusted to obtain this averaging interval.

Pressing EXIT during printing stops the job and the display reverts to normal.

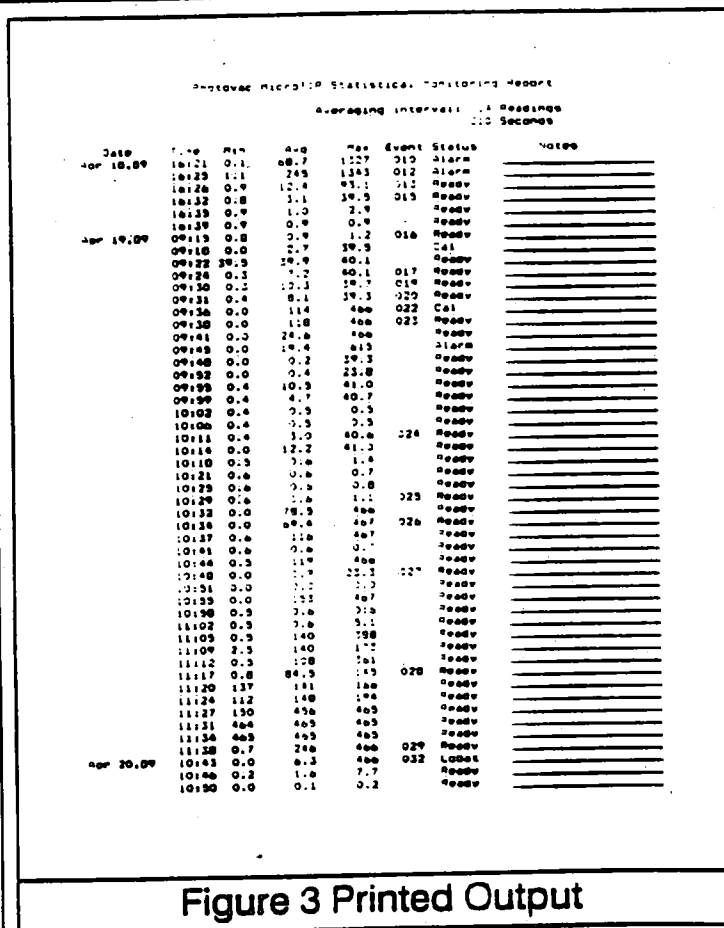


Figure 3 Printed Output

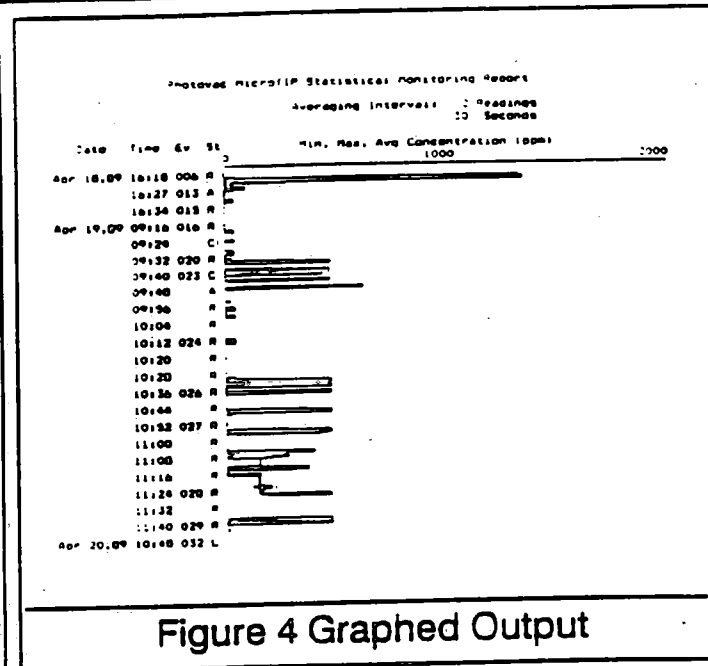
6

GRAPH

2.16 GRAPH

Pressing the GRAPH key also prints the recorded data but in graphical format. See Figure 4. The same printer and MicroTIP setup must be selected as for the Print command. In addition, set the range of the graph using the SETUP Key.

When the setup is correct, ensure the printer is on line and press ENTER. MicroTIP will format the selected data and calculate an averaging interval so that all Events between the selected start and stop points will be graphed and so that the graph is kept on a single page.



The following information is printed with GRAPH:

- The number of readings in an interval and the length of the interval is printed at the top of the page. In Figure 4 there are 2 readings in an interval and the interval is 30 seconds long.
- Time is printed once every 16 intervals. This time will be the start time of the next 16 intervals.
- The lowest Event number of the 16 intervals is printed, only if it has changed from the previous set of 16 intervals.
- The highest priority status of the 16 intervals is printed.

While the information is being printed, the display shows that printing is in progress. The keypad will not accept commands until the present print job has been completed.

Pressing EXIT during printing stops the job and the display reverts to normal.

Chapter 3 Accessories and Other Devices

3.1 COMPUTER

MicroTIP will send information stored in its datalogger to either a printer or to a computer. The computer must be set up to emulate a terminal. Connect the computer's serial port to MicroTIP's I/O connector using the printer cable and a suitable adapter (Photovac Part No. 395006). The computer must be set to 8 data bits and 1 stop bit for communication. Use the PRINT key, not the GRAPH Key. See Section 2.15.

3.2 CHART RECORDER

MicroTIP's output can be displayed as a 0-1V analog voltage on a chart recorder in real time. Set the chart recorder to 1V full scale and connect it to MicroTIP's I/O connector using the analog output cable (Photovac Part No. 395005). The concentration range of the analog output signal is selected with the SETUP key, and can be 0-20, 0-200, or 0-2000 ppm full-scale.

3.3 HEADPHONES

Connection and operation of the headphones (Photovac Part No. 395004) is described in Section 2.11.

3.4 SAMPLE BAG

MicroTIP is equipped with a sample outlet fitting (See Figure 1) from which samples may be collected for further analysis. Connect a sample bag to the fitting with a short length of 1/8" inside diameter flexible tubing.

Note: Readings may fluctuate due to changes in detector flowrate as the sample bag is filling. The bag contents will not perfectly represent the sample. Ozone produced by MicroTIP's detector will be present, and sample composition may have been altered by passage through MicroTIP's sampling pump.

3.5 THREE-METER (9.8FT) SAMPLE LINE

For remote sampling, connect the 3m sample line (Photovac Part No. 390006) to MicroTIP's sample inlet in place of the 17cm sample probe supplied.

3.6 SHOULDER STRAP

Snap one end of the shoulder strap to the steel shoulder strap connector bail above MicroTIP's I/O connector. Snap the other end to one of the shoulder strap connectors beside the display. See Figure 1. Connection point is selectable for right or left handed operation. Adjust the shoulder pad and strap length for comfort.

Maintenance Notice

Routine maintenance of MicroTIP requires the removal of the detector housing to access the detector UV lamp. This is outlined in Section 4.2. Removal of detector housing may result in the lamp holder becoming loose. Before replacing the detector housing ensure the lamp holder is securely connected to MicroTIP. Finger-tighten only. Over-tightening may result in damage to the lamp holder.

Part No. 600730

Chapter 4 Routine Maintenance

4.1 BATTERY CHARGING

When the display status reads "LoBat", the MicroTIP battery pack requires recharging. A fully charged battery powers MicroTIP for 6 hours. If the instrument is to be used for more than 6 hours, carry a spare battery pack. When the first one has been discharged, replace it with the spare. Upon return from field work, recharge both battery packs as outlined in Section 1.2. Two chargers are required to do this overnight.

The charger automatically charges at a high charge rate until the battery is fully charged and then maintains the full charge with a low continuous charge rate indefinitely so there is no danger of overcharging.

4.2 LAMP WINDOW CLEANING

During the course of normal operation a film builds up on the window of the detector ultraviolet lamp. The rate at which the film develops depends on the type and concentration of the gases and vapors being sampled and results from the ultraviolet light interacting with them. As a guide, clean the window every 24 hours of operation. To clean the lamp window:

1. Ensure the instrument is turned off.
2. Hold the black detector housing in one hand and unscrew it from the body of MicroTIP. See Figure 1. Remove the housing, being careful not to lose the o-ring seal on top of the photolization detector. The detector cell, lamp holder, and HF driver circuit board are now exposed.
3. Unplug the red and yellow wires from the HF driver circuit board.
4. Hold the lamp holder in one hand so it will not rotate and carefully unscrew the detector cell with the red and yellow wires attached. Do not touch the fine wire mesh inside the detector cell. Any dust or dirt in the detector cell can be blown out with a gentle jet of compressed air.
5. Leaving the lamp spring in place, remove the lamp from the lamp holder.
6. To remove the film, gently rub the window of the lamp with a lint free tissue moistened with methanol.

LoBat	100 ppm
042 10:20	Feb 15

7. Allow the window to dry and then, without touching the window, replace the lamp in the lamp holder.
8. Replace the detector cell squarely on the lamp holder and ensure the o-ring seal is in position. Finger tighten only.
9. Plug the yellow wire onto the gold pin and the red wire onto the silver pin on the HF driver circuit board.
10. Replace the detector housing and tighten by hand.
11. Once calibrated, MicroTIP is ready for operation.

4.3 REPLACING THE DETECTOR UV LAMP

If the lamp will not light then it requires replacement:

1. Remove the lamp as outlined in Section 4.2.
2. Remove the lamp spring from the lamp holder and replace it with the new lamp spring.
3. Without touching the window of the new lamp carefully place it in the lamp holder.
4. Replace the detector cell and the detector housing as outlined in Section 4.2.
5. Once calibrated, MicroTIP is ready for operation.

4.4 REPLACING THE FILTER CARTRIDGE

MicroTIP is equipped with a dust filter to reduce detector contamination. As the filter collects dust, MicroTIP's inlet flow rate and sensitivity decrease. Replace the filter every 240 hours of operation, or more frequently if MicroTIP is used in a dusty environment. To replace the filter:

1. Turn the instrument off.
2. Hold the filter housing near the detector housing with a 9/16" wrench.
3. Unscrew the top of the filter housing with another 9/16" wrench. Be careful not to lose the metal sealing washer.
4. Remove the spring and filter and install the new filter, open end first.

Fault 100 ppm
042 10:20 Feb 15

Detector light
intensity is low

5. Replace the filter spring and the filter housing. Tighten the top nut while holding the bottom one stationary with the wrench.
6. Once calibrated, MicroTIP is ready for operation.

4.5 REPLACING THE PUMP

Replace the sample pump every 5000 hours of operation.

1. Turn the instrument off and remove the battery pack so the instrument is easy to manipulate.
2. Turn MicroTIP upside down and remove the 4 screws securing the handle to the control housing. Then remove the two screws in the handle flare.
3. Carefully lift the handle away from the control housing. The two parts remain connected by the set of wires from the I/O connector. Locate the red sample pump mounted on the power supply board. See Figure 5.

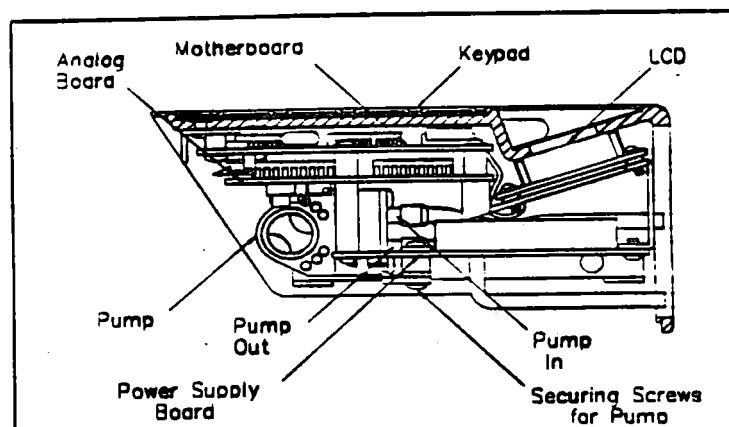


Figure 5
Control Housing Showing Pump

4. Disconnect the 2-pin pump connector from the power supply board.
5. Remove the two screws securing the pump bracket to the circuit board. Gently pull the pump out about 1/2" (1 cm) and remove the two pieces of clear tubing from the pump.

-
6. Connect the clear tubing to the new pump.
 7. Slide the pump into the proper position and secure it with two screws.
 8. Re-connect the 2-pin connector from the pump to the power supply board.
 9. Carefully position the handle over the control housing and replace the six screws from the bottom of the handle and the handle flare.
 10. Snap the battery pack into place.
 11. Once calibrated, MicroTIP is ready for operation.

Chapter 5 Troubleshooting

5.1 IF MICROTIP DRAWS IN LIQUID

MicroTIP accepts only gas and vapor samples. Aspirating a liquid may result in damage to the lamp and the pump. If water is drawn in, the affected parts of the instrument may be cleaned and dried. Contact Photovac Service if another liquid is aspirated.

1. Before taking the instrument apart allow the MicroTIP to run until no more liquid comes out of the sample outlet fitting below the detector housing. This will clean out the pump.
2. Turn the instrument off. Remove the detector cell and lamp as outlined in Section 4.2.
3. Dry the lamp with a clean lint free tissue and clean the window. See Section 4.2.
4. Clean the detector cell in distilled water, preferably in an ultrasonic cleaner.

NOTE: DO NOT touch the fine wire mesh in the detector cell and DO NOT use solvents as they will degrade the detector cell.

5. Dry the detector cell overnight at 50°C (125°F).
6. Dry the inside of the lamp holder.
7. Remove the filter cartridge as in Section 4.4.
8. Dry the inside of the filter holder.
9. Install a new filter cartridge and re-assemble the filter housing.
10. Once calibrated, MicroTIP is ready for operation.

5.2 INSTRUMENT STATUS AND FAULT DISPLAYS

The instrument status appears at the left of the upper line of the display and on the PRINT and GRAPH outputs. Each status has a priority assigned to it. If more than one status is in effect, then the status with the highest priority is displayed until the condition is corrected or until the option is turned off.

When the bar graph display or the GRAPH output is selected, the instrument status is reduced to a one-letter code.

The following table summarizes the instrument status:

Status Code	Priority	Description
Fault	F 1	One of 3 faults is occurring. Press TUTOR for details.
Over	O 2	Detected concentration exceeds 9999 on the display.
Alarm	A 3	Detected concentration exceeds the set alarm level.
Cal	C 4	Will never be observed on the display during normal operation as various calibration prompt messages are displayed while MicroTIP is calibrating. If the instrument is turned off when it is calibrating Cal will appear on the display when MicroTIP is turned on again indicating the last calibration was incomplete. Cal status is also shown on printed or graphed output.
LoBat	L 5	Battery pack power is low. Recharge or replace pack.
Play	P 6	The instrument is playing back previously recorded data.
HiSens	H 7	High Sensitivity operation.
Ready	R 8	Normal operation.

Table 2 Instrument Status

When the Fault status is displayed, MicroTIP's operation is compromised. Press the TUTOR key for a two-line description of the fault. Refer to the following table for corrective action:

Fault Description	Probable Causes	Corrective Action
Detector light intensity is low	Defective detector light source.	Replace the light source. See Section 4.3.
	Poor connection between lamp holder and driver circuit board.	Check the wire joining lamp holder to driver circuit board. See Section 4.2.

Table 3 Fault Analysis

Fault Description	Probable Causes	Corrective Action
Signal from zero gas is too high	Contamination of sample probe or fittings before detector.	Clean or replace probe. Replace inlet filter. See Section 4.4.
	Span and Zero gases mixed up.	Ensure clean gas is used to zero MicroTIP.
	Contamination in detector.	Clean detector. See Section 4.1.
Detector field voltage is low	Contamination in detector.	Clean detector. See Section 4.1.
	Short circuit in detector.	Remove detector. Ensure resistance between red and yellow wires exceeds 10 megohms.
	Internal fault in electronics	Contact Photovac Service.

Table 3 continued

Chapter 6 Technical Description

6.1 OVERVIEW

MicroTIP is a microprocessor controlled instrument for measuring the presence of ionizable chemicals in air at ppm levels. The block diagram in Figure 6 shows the main components of MicroTIP. The microprocessor controls the components of the instrument and interprets and records the signal generated by the photoionization detector (PID). Recorded data and setup information entered into the microprocessor's memory are retained when MicroTIP is turned off.

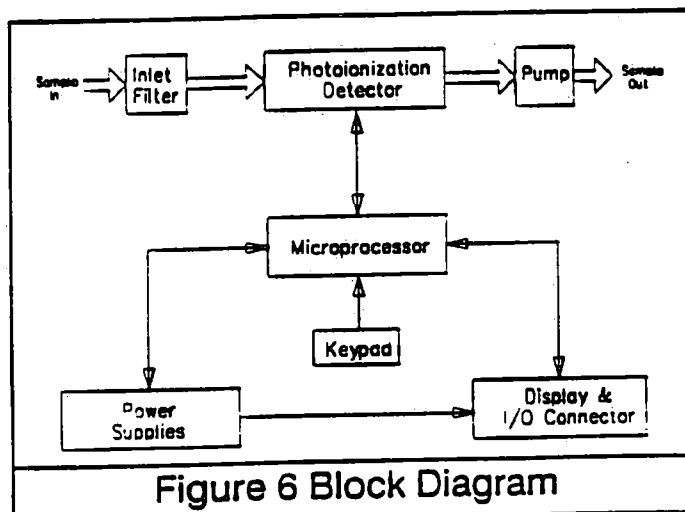


Figure 6 Block Diagram

A pump continuously pulls the air under test through MicroTIP's PID. The PID converts the concentration of ionizable chemicals in a sample into an electrical signal. The microprocessor subtracts any background from the signal and multiplies this signal by a response factor previously obtained by calibrating with a standard gas of known concentration. This concentration appears on MicroTIP's display and, depending on the values entered through MicroTIP's keypad, an alarm message may be displayed or an audio signal may be heard.

MicroTIP can detect thousands of different types of airborne gases and vapors and its response depends on the type as well as the concentration. MicroTIP does not distinguish one type of chemical from another, but displays a number indicating the total concentration of all ionizable chemicals in the sample.

A standard of isobutylene at a known concentration may be used for determining the response factor. If MicroTIP is calibrated with isobutylene, it displays concentrations in units equivalent to ppm of isobutylene. If isobutylene were the only ionizable chemical in the sample, then MicroTIP would display its concentration directly.

MicroTIP responds more or less readily to other chemicals than it does to isobutylene. Because it has a medium response to isobutylene, this gas has been chosen as a reliable means of reporting an average concentration of total ionizables present.

For special applications, gases other than isobutylene can be used to calibrate MicroTIP.

6.2 PHOTOIONIZATION DETECTOR

MicroTIP's PID is shown in Figure 7. The PID measures the concentration of ionizable chemicals in the gas stream from the sample inlet and produces an electrical signal for the microprocessor.

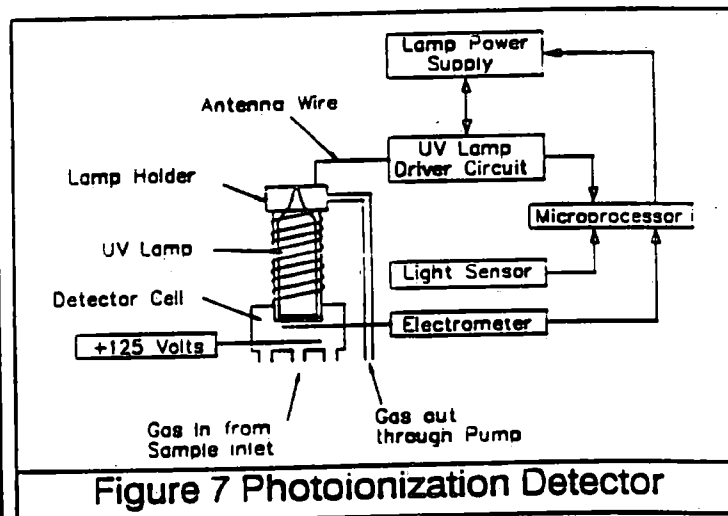


Figure 7 Photoionization Detector

An ultraviolet (UV) lamp generates photons which ionize specific molecules in the gas stream. The permanent air gases, argon, carbon dioxide, nitrogen, oxygen, water vapor etc., require a relatively high energy for ionization, and are not ionized by the UV photons. Many of the chemicals considered pollutants, including most hydrocarbons, are ionized.

The gas stream is directed into the PID through a small port at the center of the lamp window and through a series of larger ports around the perimeter of the lamp window. This bypass arrangement permits a high sample flowrate and short response time, while minimizing contamination of the lamp window.

The ionized molecules in the detector cell are subjected to a continuous electric field between the repeller electrode and the collector electrode. The ions move in the electric field, generating a current which is proportional to the concentration of the ionized molecules in the detector cell. An electrometer circuit converts the current to a voltage which is then fed to the microprocessor.

The UV lamp is operated by a lamp driver circuit which delivers high frequency energy to the lamp through an antenna wrapped around the lamp holder. The lamp driver power supply is controlled by the microprocessor based on a feedback signal from the light sensor.

6.3 CALIBRATION AND RECORDING

Periodic calibration is required to compensate for PID output changes due to inlet filter restriction, lamp window cleanliness, sample pump wear and other factors.

During calibration, MicroTIP's PID is first exposed to zero gas. A small signal is generated, and this zero signal is stored by the microprocessor.

In High Sensitivity operation, the microprocessor subtracts the zero signal from the PID signal, and multiplies the difference by 1000. This number is then displayed.

When one of the 5 Cal Memories is selected, MicroTIP's PID is next exposed to span gas. This span signal is stored. The microprocessor subtracts the zero signal from the span signal and divides the difference by the user-entered span gas concentration. The resulting response factor is stored in the selected Cal Memory with the zero signal. In operation, the microprocessor first subtracts the zero signal from the PID signal, then multiplies the difference by the response factor. This number is then displayed.

The microprocessor accumulates all readings over a 15 second interval and determines the minimum, average and maximum readings. It stores these numbers along with the highest priority instrument status and the most recent time, date and Event

number which occurred during the 15 second interval. MicroTIP automatically records these results for 12 hours of operation.

These recorded data can now be played back on MicroTIP's display. The display is identical to the numeric or graphic display, but the instrument status is "Play" indicating that recorded data, not real-time data, are being displayed. During playback MicroTIP continues to analyze and record new data.

Recorded data can also be printed as either a table or a graph. Data are automatically averaged to fit on one 8 1/2" x 11" page; the averaging interval and number of readings averaged are shown at the top of the page.

Note: For each averaging interval, MicroTIP prints the minimum of all the minima, the average of all the averages and the maximum of all the maxima.



Chapter 7 Specifications

Size:	16.8" (43cm) long, 3.75" (9.5 cm) wide, 5.75" (14.6 cm) high
Weight:	6 lbs (2.8 kg)
Detector:	Photoionization, bypass type, with 10.6 eV HF-excited electrodeless discharge tube
Keypad:	16 key silicone with tactile feedback
Display:	2 line, 16 character dot matrix, liquid crystal with adjustable backlighting, for alphanumeric or bar graph readout
Charge/Discharge Time:	8 hours/6 hours
Battery Charger:	Automatically charges and maintains full charge in battery pack
Datalogging Memory:	25k
Chart Recorder Output:	0-1V full scale
Serial Output:	RS232 (300-19200) with odd, even or no parity; for tabular and graphic printouts
Audio output:	Continuous concentration-modulated tone or tone on alarm only
Inlet Connection:	1/8" stainless steel compression fitting
Inlet Filter:	Replaceable stainless steel, 2 micrometers
Inlet Flowrate:	Exceeds 500 mL/min.
Outlet Connection:	1/8" stainless steel barb fitting
Materials in Sample Stream:	Stainless steel, Teflon, Viton
Operating Concentration Range:	0.1 to 2000 ppm isobutylene equivalent

Chapter 8 Warranty

MicroTIP is warranted for one year from defects in materials and workmanship.

Photovac Incorporated warrants that its manufactured products (except Detector Light Sources which carry specific warranties) will be free from defects in materials and workmanship for a period of one (1) year from the date of receipt by the Customer. This Warranty applies to proper use of the equipment by the customer and may be voided if, in the opinion of Photovac Incorporated, the product has been abused or treated in a negligent manner so as to cause damage or failure. Negligent use includes, but is not limited to, exposure of the internal parts of the equipment to water. Damage caused thereby is expressly excluded from this Warranty.

When Photovac is made aware of a problem in MicroTIP which would be eligible for remedy under Warranty, it will issue a Return Authorization Number to the Customer. No return will be accepted unless such authorization has been obtained.

If upon receipt of the equipment Photovac determines that repairs should be done under Warranty, Photovac's sole liability shall be for labor and materials necessary to put the equipment into proper order and return this to the Customer as promptly as possible. Photovac is in no way responsible for any inconvenience or loss, consequential or incidental, caused to the Customer as a result of the equipment being out of commission.

The Customer is responsible for shipping and insurance to the designated Photovac Service/Repair facility.

In USA

Photovac International
Incorporated
741 Park Avenue
Huntington, New York
11743
(516)351-5994

In Canada

Photovac Incorporated
105 Doncaster Avenue
Thornhill, Ontario
L3T 1L6
(416)881-8225

Outside USA and Canada: Contact the the Photovac representative in your area.

Note: MicroTIP does not carry an Intrinsic Safety Rating at this time and should not be operated in a Hazardous Location in which combustible mixtures may be present.



Index**A**

Adapter, Gas Bag 10
Alarm 8
ALARM Key 4, 8
Alarm Status 22
Analog
 Board 19
 Output 7, 15
Antenna Wire 25
Aspiration of Liquid 21
AUDIO Key 4, 8, 9
Audio
 Output 7, 28
 Volume 8
Average Concentration 3, 9
Averaging Interval 12, 13, 14, 27

B

Backlighting 5
Bar Graph
 Display 7
 Range 5
Batt 5
BATT Key 4, 5
Battery
 Charger 1, 17, 28
 Charging 1, 17
 Pack 1, 19
Baud Rate 12
Bypass Arrangement 26, 28

C

Cable, Printer 11
CAL Key 4, 10
Cal
 Memory 8, 10, 26
 Status 22
Calibration 10, 24, 26
 Kit 10
Chart Recorder 15
 Output 28
Cleaning
 Lamp Window 17
 MicroTIP 21
CLEAR Key 6

Collector Electrode 26
Computer 15
Computer Setup 15
Concentration
 Range 28
 Average 3, 9
 Maximum 3, 9
 Minimum 3, 9
Control Housing 19

D

Data, Overwritten 7, 9
Datalogging Memory 3, 4, 28
Date 3, 8
Deep Discharging 6
Detected Concentration 3
Detector
 Cell 17, 21, 25,
 Housing 1, 17
 Photoionization 24, 25, 28
 UV Lamp, Replacing 18
Direction, Playback 9
DISPLAY Key 4, 9
Display 1, 5, 28
 Options 5
 Bar Graph 7
 Fault 21
 Normal 3
 Numerical 5
Dot Matrix Printer 11

E

Electrical Signal 24
Electrometer 25
ENTER Key 4, 5
EVENT Key 4, 6, 7, 9
Event 6
 Counter 6
 Number 3, 6, 12, 26
Exit 7
EXIT Key 4, 7, 12, 14

F

Fault
 Description 22

-
- Display 21
Status 22
Filter Cartridge 1, 21
 Replacing 18
 Housing 1, 18
Filter Spring 18
Flowrate, Inlet 28
Freeze, Playback 9
- G**
Gas Bag 10
 Adapter 10
Gas
 Span 10, 26
 Zero 10, 26
Gases, Ionizable 3
GRAPH Key 4, 13
Graph 13
 Output 7, 14, 21
Graphical Form 3, 13
- H**
Handle Flare 1, 19
Headphones 8, 15
HF Driver Circuit Board 17
High Sensitivity
 Calibration 11
 Operation 11, 26
Hisens Status 22
- I**
I/O Connector 1, 8, 11, 15
Inlet Filter 28
 See also Filter Cartridge
Inlet
 Connection 28
 Flowrate 28
Instrument Status 3, 9, 21
Interval, Averaging 12, 13, 14, 27
Ionizable
 Chemicals 24
 Gases 3, 24
 Vapors 3, 24
Isobutylene 25
- K**
Keypad 1, 4, 13, 14, 19, 24, 28
- L**
Lamp Holder 17, 18, 21, 25
Lamp Power Supply 25
Lamp Spring 17
Lamp Window 26
 Cleaning 17
LCD 19
LIGHT Key 4
Light 5
 Sensor 25
LoBat 5, 17
 Status 22
- M**
MAX Key 4, 6
Max 6
 Register 6
Maximum Concentration 3, 9
Memory
 Cal 8, 10, 26
 Datalogging 3, 4, 28
Methanol 17
Microprocessor 24, 25
MicroTIP, Cleaning 21
Minimum Concentration 3, 9
Motherboard 19
- N**
Normal Display 3, 5, 6, 7, 8, 9.
Notes 12
Numerical Display 5
- O**
Options
 Display 5
 Print 11
Outlet Connection 28
Output
 Analog 7
 Audio 7, 28
 Chart Recorder 28
 Graph 21, 14
 Print 21, 13
 Serial 28
Over Status 22
Overwritten Data 7, 9
Ozone 15

P

Parity 12
 Photoionization Detector 24, 25, 28
 PLAY Key 4, 9
 Play 9
 Status 22, 27
 Playback
 Direction 9
 Freeze 9
 Speed 9
 Power Supply Board 19
 Power Switch 1, 3
 PRINT Key 4, 11
 Print
 Options 11
 Output 21, 13
 Printer
 Cable 11
 Setup 11
 Priority 9, 14
 Pump 21, 24
 Bracket 19
 Connector 19
 Pump In 19
 Pump Out 19
 Replacing 19

R

Range
 Bar Graph 5
 Concentration 28
 Ready Status 22
 Recharging, Battery 1, 4, 5,
 Recording 6, 9, 26
 Regulator 10
 Release Button 1
 Repeller Electrode 26
 Replacing
 Detector UV Lamp 18
 Filter Cartridge 18
 Pump 19
 Response Factor 11, 24, 28
 Return Authorization Number 29

S

Sample
 Bag 15
 Inlet 1
 Line (3 metres) 15
 Outlet 1, 15
 Probe, 17 cm.
 Serial Output 28
 Service 29
 SETUP Key 4, 7, 11
 Setup 7, 11
 Computer 15
 Printer 11
 Shoulder Strap 1, 16
 Size 28
 Span
 Gas 4, 10, 11, 23
 Signal 26
 Speed, Playback 9

T

Tabular Form 3
 Terminal Emulation 15
 Time 3, 8
 TUTOR Key 4, 22
 Tutorial 4

U

Ultraviolet Lamp 25

V

Vapors, Ionizable 3, 10, 11, 17, 21, 24, 25
 Voltage Selector Switch 1
 Volume, Audio 8

W

Warranty 29
 Weight 28

Z

Zero
 Gas 10
 Signal 26

OPERATING INSTRUCTIONS

1. Slide back electrode compartment to release pH and conductivity electrodes.
2. Deploy electrodes in either the 90 or 180 degree measurement position.
3. Energize by depressing the On/Off switch once.
4. Immerse electrodes into solution to be measured. For proper operation, immerse electrodes 1/2 their length.
5. When energized, the LCD enunciator will indicate which parameter is being measured. E.G. pH, PPM (μ S), or PPM (μ S) X10. Only the 200K range utilizes the X10 enunciator. 20K and 2K are direct readings. Note selection sequence in #7. Overrange conductivity is indicated by a 1. Proceed to higher range for reading.
6. Agitate electrodes briefly and observe the reading.
7. For each range change desired, depress the pH/PPM (μ S) switch once. This unit utilizes 3 ranges of conductivity. The range sequence is: pH-200K-20K-2K.
8. Rinse electrodes thoroughly and replace pH storage cap before returning to storage compartment.

CALIBRATION INSTRUCTIONS

Your instrument has been pre-calibrated prior to shipment. Calibration should be performed periodically with fresh pH buffers and known conductivity solutions.

pH MODE

1. Rinse the pH probe in distilled water.
2. Insert in a fresh #7 buffer solution.
3. Slide back the battery compartment cover to the first stop exposing the adjustment pots.
4. Adjust the CAL pot until the display reads 7.00.
5. Remove probes, rinse and insert in a #4 or 10 buffer solution.
6. Adjust the SLOPE pot until the display reads the correct value.

CONDUCTIVITY MODE

1. Rinse probes thoroughly by agitating in pure water.
2. Wipe off conductivity probe and allow to dry.
3. Once dry, conductivity should read 0 in air.
4. Adjust ZERO pot if reading is incorrect.
5. Immerse sensor in known conductivity solution. Adjust SPAN pot to desired conductivity value.
6. Only a single point calibration in the 2K range is required to standardize. However, if unit is to be used primarily in higher ranges, it is recommended that the single point calibration be performed near point of use for best resolution.
7. Rinse probes and return to storage compartment.

HELPFUL HINTS

1. Electrodes should be rinsed thoroughly after each test.
2. Be sure to replace the protective pH cap after each use.
3. Fill the cap with a small amount of pH 4 buffer or tap water.
4. If the conductivity probe does not zero, it may indicate dried solids on the sensor. Clean with a mild detergent solution.
5. For best results, calibrate pH with a buffer that is within 3 pH units of the test sample.
6. Choose a conductivity calibration solution that is near the samples to be measured.
7. Remove the battery when the instrument will be stored for a long period.

DspH-3 pH/3 RGE. CONDUCTIVITY METER

